JAN 23 1926

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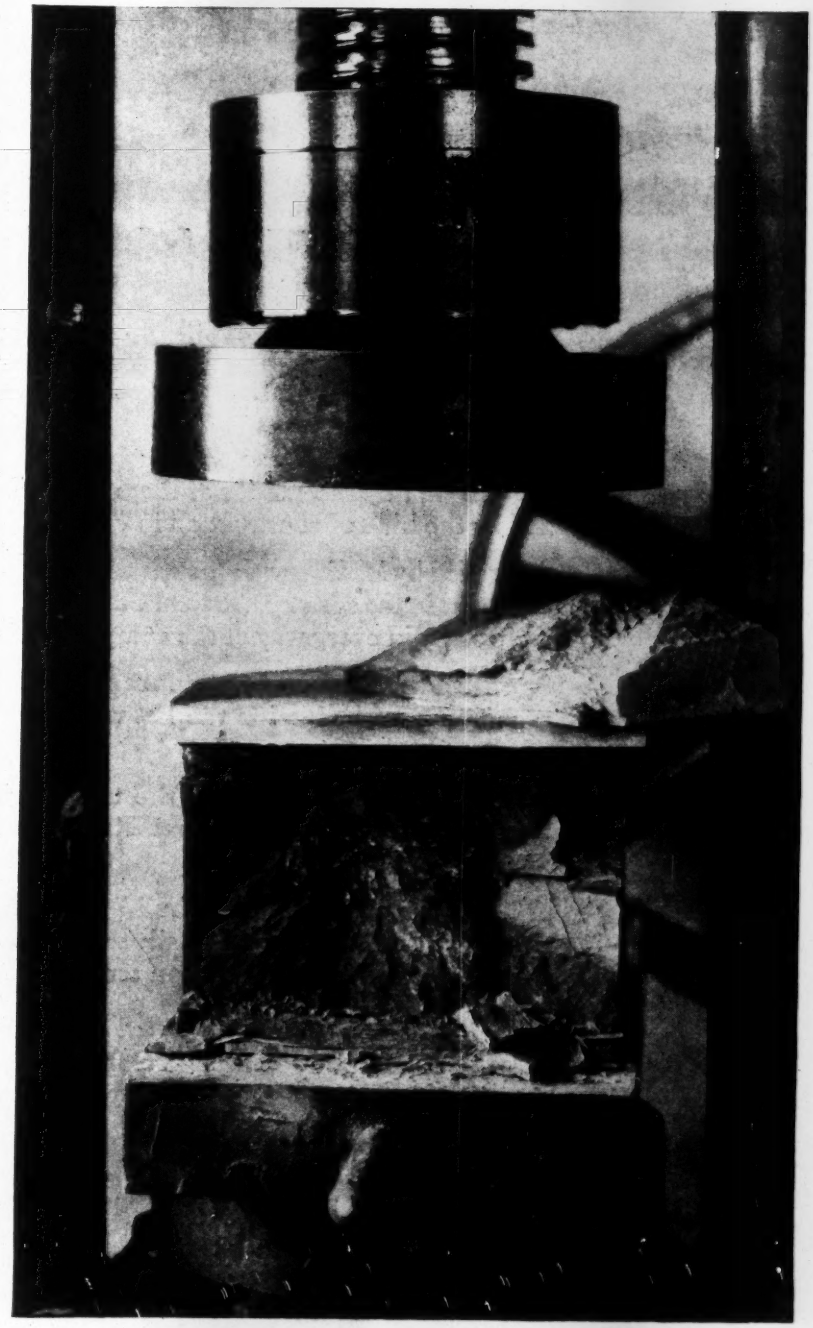
January 21, 1926

Engineering News-Record



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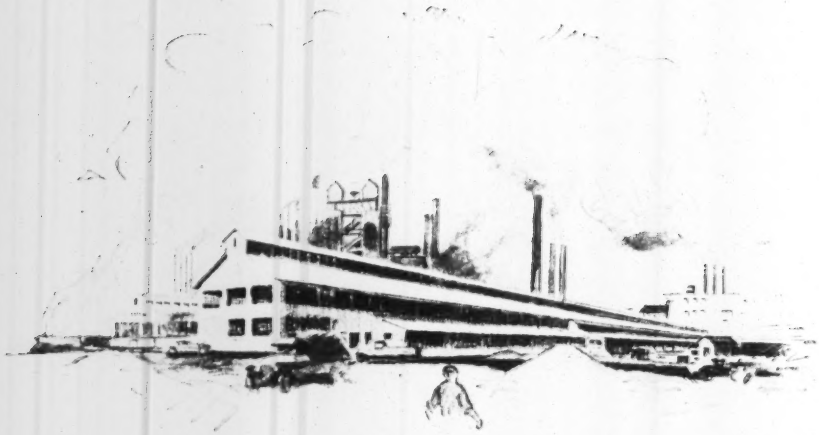
Highway Bridge
Construction
in 1925—II

Staff Report
of the American
Road Builders
Convention and
Road Show



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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 96 NEW YORK, JANUARY 21, 1926 Number 3

Road Lessons from Chicago

FEW meetings of road builders have expressed better the breadth of highway engineering interests than that held at Chicago last week. A catalog of the subjects considered includes road costs and profits, highway financing, location economics, traffic, construction methods, road design and structure, highway maintenance, relations of roads and railways and contractual relations. These subjects, too, were all given the tribute of interested audiences and of more extensive discussion than is often heard at an open meeting of road builders. With the exhibition of equipment and materials they survey about all the territory embraced in the modern road builder's work. It is notably a broad territory with far prospects for the engineer. He must be a strong man to carry on to their boundaries. He must be more than a technician and more than a business manager and far more than a politician. Today the greatest danger is that the politician will hold dominance. In the year past he has exhibited recurring strength. One instance or another can be cited where the political administrator has taken the initiative out of the hands of the engineer director and more than once he has shown greater technical vision and courage. There must be the technician in road building but the engineer who is to captain the industry has to be much more or be content to be the hired man of the public roads business as he has become generally in the railway business. This is the big thought which one gets from the study of the great convention and exhibition of road builders at Chicago a week ago.

The Equipment Maker's Contribution

IT WOULD be a good thing if every engineer and contractor in the United States could go to the Road Show in Chicago. This annual exhibition, the current one of which was held last week, is ostensibly designed to benefit the road contractor, but the collection of construction and maintenance machinery there displayed is so extensive and so inclusive that it embraces a major part of the equipment now used in construction. This, in its way, is evidence of the enlarging technique of road construction. No longer is the building of the highway a job for the casual farmer, working out his debt to the state or county; it is a concentrated engineering operation demanding all of the mechanical aid that make such operations efficient. Every year since the advent of the motor car, with its demand for more and better roads, has seen more and better road building machinery. Some of this has been of a type required only on road work, such as the concrete pavers and finishers, but much of the development for road-building machinery in particular has been capitalized for other kinds of construction. That is the reason why every one connected with construction would be informed by visiting the Road Show and seeing brought together under one roof the accumulated development of the equipment makers' art. Unfortunately no building exists today that will permit of a proper display of this exhibition. The Coliseum at Chicago is apparently the best available but it is woefully inadequate. Only a part of those wishing to exhibit can be accommodated and the space requirements for those admitted makes congestion altogether too great for proper study of the exhibits. Nevertheless the variety of the machinery, the engineering skill exemplified in the machinery itself and the size and complication to which some of the machines have been developed make the show one of the most useful, and at the same time most impressive, demonstrations of how greatly the manufacturer is contributing to the simplification and cost reduction of construction.

Score One for the Air Mail

ON THURSDAY last week at 3 o'clock one of the editors of *Engineering News-Record* learned of a pamphlet which had been issued by a cement company in Chicago containing material needed in some work then in hand. He made a vain effort to obtain it in New York and finally at half past three wired the Chicago office of the company to drop the pamphlet in the air mail that night. The telegram was received in Chicago shortly before five o'clock, just ten minutes before the air mail box closed, but by rush work a messenger got it there in time. At nine o'clock Friday morning the envelope with its required document was on the desk of the editor in the New York office. This is real service. There have been criticisms of the air mail. This one experience, however, shows what can be done. Any such pioneer work must necessarily be slow in development, but a good deal of initial discomfort can be put up with if finally Chicago can be made within overnight delivery from New York. The Post Office should be given every opportunity to develop such service.

Wind and Weather

REPORTS of great floods in southern Mexico, with estimates of as many as 2,000 deaths, form a strange consonance with the flood news from Europe last month and the early part of this. Unprecedented stages of water occurred in so many streams that the current season will probably claim a prominent place in the register of floods. It is a noteworthy contrast that the United States area was quite free from large floods in 1925—an unusual condition. Apparently these are abnormal meteorological times. The year past made its mark as a tornado and earthquake year, besides being one of erratic precipitation conditions. It began its record early with the southern Illinois tornado of

March 18, which killed hundreds and did vast damage, a tornado phenomenal in length of path and maintained intensity. Later came the series of earthquake disturbances which ranged from the St. Lawrence valley to Montana on the one hand and southern California on the other and culminated in the devastation of Santa Barbara. Students of seismic history now claim that this is only part of a world-wide earthquake spasm greater than has been known for many years, even several centuries, past. The abnormal hydrologic conditions of the past few months are a further indication that the physical globe is rather out of its regular habits for the time being. All these developments engage the engineer's concern. They give increased emphasis to flood protection study and to consideration of the possibility of erratic precipitation. Floods are accountable for vast totals of destruction in the world's history, and correpondingly large expenditures are warranted to protect against them. In the same way, we are progressing toward definitely planned protective measures against tornado and earthquake ruin. The attention directed to these forms of nature's visitation by last year's happenings is a beginning of what may grow to be an extensive branch of engineering art.

Fifty Years of Service

ENGINEERING NEWS-RECORD is glad to welcome into the select society of 50-year old technical journals its friend and neighbor, *The American Architect*, which this week is celebrating with a Golden Anniversary Number. The half-century progress of any art or science is difficult to record. Considered selection is necessary for proper emphasis and illustration's aid must be carefully used. Our contemporary has succeeded admirably in its task of portraying the development of American architecture since 1876.

Municipal Employees and the Income Tax

THE decision of the United States Supreme Court in the Metcalf & Eddy income tax suit, on Jan. 11, is probably what most consulting engineers expected, including the original plaintiffs. Nevertheless a service has been rendered to the profession generally by obtaining a pronouncement from our highest court on whether consulting engineers when engaged on public work come under the clause of the War Revenue Act of 1917 that exampts federal, state and municipal "officials and employees." Inferentially, the decision gives hope that when representatives of the army of water-works men of the country get their case before the Supreme Court the belated efforts of the Commissioner of Internal Revenue and his district agents to collect income taxes from them, retroactive to 1917, will be declared futile.

In passing, it may be said that were it not for this effort to collect the income tax back to 1917, the points at issue would be chiefly of academic interest in view of the recent diminution in the tax on such small incomes as fall to the lot of most public officials, however it may be with consulting engineers. Tax payments come hard enough at best. When demanded on incomes already long since spent they are heart breaking.

The gist of the decision, in its broad application, is that consulting engineers must pay the federal tax on incomes from federal, state or municipal governments unless they are regular officials or employees thereof. This is what the trial court declared. but without definition—now clearly supplied. The Supreme Court holds as test of occupying official position in nation, state or city, appointment by a government and taking the oath of office, with "duration. emolument and duties fixed by law." Contracts for services, "although entered into by authority of law and prescribing" duties "could not operate to create an office or give to plaintiffs the status of officers." Taking up the term "employees," and giving the language a broad application under all like conditions, consulting engineers are not public employees under the terms of the revenue act, but are "in the position of independent contractors."

So much for the exemption clause of the War Revenue Act of 1917. From this clause the Supreme Court passes "to the more difficult question whether Congress had the constitutional power to impose the tax in question—meaning, presumably, a tax that would hold against consulting engineers working for any branch of the government, even though "independent contractors." The specific language used and authorities cited in this part of the opinion go into the old mazes of what is and what is not a government function, with the conclusion that "one who is not an officer or employee of a state does not establish exemption from federal income tax merely by showing that his income was received as compensation for service rendered under a contract with the state." Nor, the Supreme Court holds, is there any substantial impairment of the "ability of plaintiffs in error to discharge their obligations to the state or the ability of a state or its subdivisions to procure the services of private individuals to aid them in their undertakings."

Most of the opinion thus far cited and commented on relates to the appeal of Metcalf & Eddy from the lower court rulings on 18 items of taxation of income from states or cities the governments of which the lower court held in effect, and the Supreme Court specifically rules, the plaintiffs had only contractual relations. As to the remaining items, one for services as engineer of a Maine water district and one as a member of an engineering board for an Illinois sanitary district, the Supreme Court merely affirms the exemption granted by the lower court on the ground that the plaintiffs were officials or employees of these districts, thus passing the matter over without detailed opinion because "the Government does not press its writ of error in this case"—the "Government" here being the administratrix of the estate of the collector of internal revenue for Massachusetts.

In view of the Supreme Court's definition of what constitutes public "officials and employees," its affirmation of the decision of the lower court, and the failure of that court to press its appeal on the two items, some may assume that even if on constitutional grounds the courts continue to hold that water supply is not a governmental function yet officials and employees of municipally-owned water-works are cleared from paying income taxes (retroactive to 1917) because of the specific exemption of public officials in the 1917 War Revenue Act; but court records show that such assumptions are not always safe until borne out by an actual ruling by the United States Supreme Court. Therefore water-works men and their representatives,

through the various associations and the legal departments of their respective municipalities, should bring the specific question to a final decision by the United States Supreme Court. Already the employees of the Detroit municipal railway department have obtained a decision—in their favor, too—from the Federal Court for the Michigan District. It is hard to see how if street railway service is a governmental function, as the trial court decided, water supply can be classed otherwise.

Free Government Engineering Again

IN ITS proper rôle as the investigator of fundamental physical data of an engineering nature the government is in constant danger of stepping over into the rôle of consulting engineer. Pressure from citizens anxious for free advice or uncertain as to the methods of obtaining professional advice tends inevitably to an official leniency as to the boundaries of that twilight zone which lies between the recording of data and the deductions from that data. However appreciative the government engineer may be of the dangers that lie in free government advice every so often in his zeal to justify his activities—and perhaps to gratify the scientist's suppressed desire for practical expression—he becomes a consulting engineer. And when he does he not only is unfair to the engineering profession but he is misleading the citizens whom he is presuming to advise.

Unfairness to the profession is obvious, for the government should no more compete with the engineer than it should with the grocer, the doctor or the contractor. For its own activities it may reasonably perform all these functions, but it must not enter the open field, unless we are ready for complete communism. The misleading of citizens may not be so evident, but it is nevertheless true, for the community or individual seeking advice will not appreciate that the advice given is only basic information superficially directed toward the special problem and will asume that here is the basis on which the layman may proceed to an engineering solution.

The best way for engineers to fight any such tendency on the part of government bureaus is to protest every time there appears to be the slightest deviation from a strict interpretation of the rule against government professional service. Whether that deviation is intentional is immaterial; the effect is the same whether or not the government officer realizes how far he is going. Thus some years ago the then Office of Public Roads initiated in perfect good faith what was nothing more nor less than a free engineering service in highway bridge design. Protest was immediate and emphatic and the service was soon withdrawn.

For that reason we think it necessary to call attention to a recently circulated bulletin of the Department of the Interior which under the heading "Water Supply for Alexandria County, Virginia," gives a fairly elaborate report on the water resources of that district and the preliminary procedure, at least, toward providing a public water supply. The first two paragraphs are illuminating:

"The matter of obtaining a suitable public water supply for the Arlington and Washington districts of Arlington County, Va., has been receiving considerable attention recently. These two districts constitute the part of the county away from the immediate vicinity of Alexandria. Mr. H. A. Saffell, chairman of a committee representing local citizens' organizations, asked the advice of the Department of the Interior through its Geological Survey, as to the possibility of utilizing ground-water for this purpose. Such data as are available have been assembled and studied by Clyde P. Ross, one of the geologists of the Survey. His report has been submitted to Mr. Saffell, and a copy is on file in the office of the Geological Survey, where it may be consulted by anyone interested. The conclusions and recommendations are given below.

"The communities near Alexandria are or can be supplied from the Alexandria city water system, which draws its water from a reservoir on Holmes Run. According to the census reports the Arlington and Washington districts together had a population of 4,517 in 1900, 7,559 in 1910, and 12,372 in 1920. The increase in population since 1920 has been rather rapid, and this growth may be expected to continue for some time to come. A public supply for these districts should therefore be large enough for at least 15,000 people, with possibilities of future expansion. The districts are almost exclusively residential. Most of the water would be used for domestic purposes alone and the average requirements per capita would be less than in most towns of similar population. A supply of a million gallons a day might be adequate for present needs, although it would not be liberal, especially during seasons when water is desired for gardens."

The remainder of the report explains the details of proposed wells, gives some information on the quality of water, argues the desirability of a well supply as against surface water, generalizes on pumping machinery and suggests the drilling of test wells.

This is not a particularly flagrant case of free advice, but the time to swat the camel's nose is when it appears under the tent. The citizens of Alexandria County seem to feel the need for a better and more extended water supply. There are numerous competent engineers in the country who can tell them how to get it. Such an engineer in his studies will gladly avail himself of such information as to water conditions as the government has accumulated in its study of the resources of the country. He will be able to balance that information, to discard that which is immaterial and to decide proper measures for the provision of a supply. But the citizens who now have this bulletin may well be under the impression that it is a complete engineering study of their necessities and one on which they can now proceed with the minimum of engineering assistance. As such it is an injudicious extension of governmental activity, however unimportant it may be as an actual case.

The Geological Survey is now seeking congressional authority for an extension of its water investigation powers. As was said in these columns some weeks ago, this seems a reasonable request looking toward greater governmental efficiency. But, as was also said here, such studies should be purely basic, the accumulation of necessary data for such use as they can be put by those contemplating development of the country's water resources. If the Survey has in mind the building up of a great consulting reservoir for the use of the layman, Congress would do well to hedge its grant about with restrictions that will prevent such a mistake.

Road Builders Review Highway Development

Highway Costs and Savings—Road and Railway Co-ordination — Financing and Location — Making Contracting Pay—Pavement Structure—Construction Methods—Resurfacing and Maintenance

A NOTEWORTHY program was provided last week at the convention in Chicago of the American Road Builders' Association. Besides speakers of national reputation at the opening session and at the banquet, the engineers, contractors and industrialists who prepared papers for the regular sessions were men of standing in their particular lines of endeavor. Broadly the technical program was separated into a division of engineering and a division of construction and both joint and separate sessions were held as the differentiation of subjects made desirable. This arrangement seemed to encourage discussion. At least there was more discussion from the floor than has been heard in recent years at conventions of this association. In reviewing this discussion and the formal papers, they have been grouped under headings indicating their character without consideration of their order in the convention proceedings. This it is believed will afford a better picture of the work accomplished.

Highway Costs and Savings—In his opening address the association's president, Wm. H. Connell, sounded the keynote of costs and savings which several speakers followed as the proceedings continued. He stated that about $51,750,000 annually is being saved in Pennsylvania in motor vehicle operating costs as a result of the construction of 4,500 miles of hard road since 1911. For the whole country, on the basis of 133,000 miles of hard-surfaced roads and 153,000 miles of gravel roads built since 1904, he put the saving at $1,630,000,000 annually. These figures are premised on 25 per cent higher operating cost on dirt than on paved roads and 10 per cent higher on dirt than on gravel. The traffic was assumed as 1,000 vehicles a day in Pennsylvania and 700 a day for the United States, with 90 per cent passenger cars and 10 per cent trucks. The operating cost per mile on paved roads is assumed as 10c. for automobiles and 36c. for trucks and on gravel as 11.4c. and 40.4c. respectively. The annual cost of the 4,500 miles of paved road in Pennsylvania is $19,350,000. On the mileages given above the annual cost of paved and gravel roads in the United States is $751,000,000. In brief, the saving in motor vehicle operating costs, both in Pennsylvania and in the United States, greatly exceeds the annual costs of improved highways.

Reviewing the Illinois road improvement program Governor Len Small stated that under "average conditions of grading and bridging" the construction cost of 18-ft. concrete road was being kept under $30,000 a mile. He pointed to the fact that in five years 4,365 miles had been built and that in one year, 1924, a total of 1,230 miles was completed. Speaking of future progress he stated: "We are now letting the few remaining contracts required for completing the $60,000,000 bond issue system, and during this year, 1926, we hope and fully expect to start work on the new roads ($100,000,000 bond system) and every effort will be made to complete at least 1,000 miles of durable, hard-surfaced pavements during the year 1926. Within the next three or four years we expect to have completed with a durable hard surface not less than 18 ft. in width a system of at least 8,000 miles of state trunk highways."

Commenting on road improvement statistics, Charles M. Schwab said, "I look upon money expended on public roads as in every sense an investment which yields high returns to all the people, returns by the most desirable method by which profits can be realized; namely, through economy in the actual conduct of the day's work. The saving to our farmers and to all our people, and in the reduced wear and tear on motor cars and vehicles generally through improved roads, is infinitely more than the cost of interest and maintenance on these roads."

Road and Railway Co-ordination—Three papers of more than usual significance on the relations of railway and motor truck transportation were read, two by presidents of railways and one by the vice-president of a large motor-truck manufacturing company. Taking the stand that there was no legitimate conflict between the fields of motor-truck and railway freight transportation, F. H. Alfred, president of the Pere Marquette R.R., said, "The railroads are largely benefited by better roads. Modern highways are *supplementing* the railroads by bringing them within easy access of communities that are 10, 20 or even 50 miles distant. Railroads are further benefited by the increased traffic which results from highway improvement due to, first, hauling the material for constructing the roads, and second to that which is much more important and lasting, namely, hauling the commodities produced under the stimulus of good road transportation. They also benefit from the desire to travel, which the automobile in connection with improved highways, has brought to our people."

"As far as railroads and motor vehicles are concerned," said C. H. Markham, president of the Illinois Central R.R., "it seems to me, the problem is one of co-ordination rather than one of competition." In the last five years there had been a steady decline in the total number of passengers carried by the railroads. Long distance travel and commutation travel had increased—all the loss had been in travel between nearby points. "No system of public transportation," he thought, "could successfully compete for this business with the private passenger automobile." On the other hand he looked for increasing long-distance and commutation travel by railway. For freight transportation there had been considerable development in the use of the motor vehicle. In some respects that development had conflicted with the service performed by the railways, but in other respects it had aided railway service. "That is true because package freight, especially on short hauls, is costly for the railroads to handle. On long-haul freight traffic the motor truck cannot compete with the railroad." Mr. Markham pointed out also that railways handle an enormous volume of traffic as a direct result of the development of highway transportation. Practically all the road-making machinery and supplies and materials are handled by the railroads.

Then there is the motor vehicle industry itself to give freight. He said:

"Among the principal patrons of the Illinois Central R.R. are concerns engaged in handling road-building materials and machinery and in the production and distribution of motor vehicles, accessories, gasoline and so on. It may surprise some of you to know that, according to our best estimate, the freight revenue received by our railroad from handling the various products connected with motor vehicles and good roads is more than one-eighth of our total freight revenue. Of course the proportion will vary with different railroads, but I have no doubt that this traffic provides the railroads generally with a substantial part of their total freight revenue. There is no way to determine exactly the loss in revenue sustained by the railroads as a result of motor vehicle competition. This loss is partly offset by the gain in revenue caused by the use of motor vehicles to extend the areas that enjoy convenient access to railway facilities. However, even if the disparity between this loss and this gain is large, I am fully convinced that when we take into consideration the extensive traffic derived by the railroads from the transportation of road-building materials and machinery, automobiles, gasoline and various allied products we can feel that the railroads have gained more than they have lost through the development of highway transportation."

Both speakers for the railways, however, demanded in justice public regulation of motor vehicle traffic for hire and contended that this traffic should pay adequately for the maintenance of roads built entirely at public expense. To these assumptions vigorous exception was taken by T. R. Dahl, vice-president of the White Motor Truck Co. He said:

"Taxes on motor vehicles during 1924 amounted to half the total highway bill of the nation. This bill, according to the Bureau of Public Roads, was $1,181,000,000. Motor vehicle taxes amounted to $551,000,000. These taxes collected from motor vehicles equal 92 per cent of the expenditures for the state and federal road systems, the highways which carry 80 per cent of the traffic. State license fees alone were more than twice the amount required for the upkeep of the state roads. Taxes collected by the federal government from motor vehicles have amounted to twice as much money as the federal government has expended for federal aid on highways. The figures conclusively prove that the motor vehicle paid 42 per cent of the entire highway program of the country and actually paid 92 per cent of the cost of the highways which carry 80 per cent of the traffic. To say, therefore, that the highways were built wholly at public expense may immediately be corrected to the extent that 42 per cent at least was paid by the motor vehicle itself, and when it is considered that 80 per cent of its traffic is on federal-aid highways and main market systems of the state, and that the motor vehicle paid 92 per cent of the cost of such highways, it is more accurate to say that motor vehicles paid somewhere near 90 per cent of the cost of the highways over which they operate. Considering again the entire bill for highways in this country, the 58 per cent of their cost which was not paid by motor vehicles was paid for out of bonds, federal aid, property taxes and general taxes on all business."

Financing and Location—Perhaps the most notable pronouncement of recent years on highway financing was that made by T. H. MacDonald, Chief, Bureau of Public Roads, that conditions indicated that drastic changes are necessary in legislative and administrative highway policies. From an elaborately statistical study his conclusions are:

1. The major responsibilities of the public business of the nation fall most heavily upon the local rural and urban governments, next upon the federal government and least upon the state governments. The ratio fixed by 1923 expenditures is about 6.1 local, rural and urban; 3.5 federal, 1.5 state.

2. Federal expenditures over several years for highways are about 2.5 per cent of total federal budget. For 1925, the peak, about 3 per cent of 1925 total federal expenditure.

3. The failure of one governmental agency to do a full share of any activity common to all does not lessen the total expense for this activity, but only shifts the burden between budgets.

4. There is a direct relation between bonds and progress in the construction of durable roads evidenced by the fact that only those states which have issued bonds have made any considerable progress in the mileage of durable pavements built. At the end of 1924, of the 467,000 miles of surfaced highways reported, 65.8 per cent were low type, 24 per cent were medium, and only 10.2 per cent consisted of the more durable forms of pavement.

5. The pay-as-you-go policy adopted by a considerable number of states is having two principal effects. First, to limit the expenditure of funds to types of road that admittedly are not adequate for present traffic. Second, to force upon the counties bond issues. In 24 states which have no state bond issues there have been issued since 1921 upwards of one-half billion dollars in county road bonds, and these same states had issued prior to 1921 about the same amount in road bonds, again supporting the conclusion above that the failure of one governmental unit to carry a full share of the cost of this public undertaking is only shifting the burden to other units of government and increasing rather than decreasing taxes.

6. Of the funds available for expenditure under the supervision of the state highway departments in 1924, 15.9 per cent was transferred from counties, 16.5 per cent came from federal aid, 40 per cent from motor vehicle fees and gas tax. That is, 72.4 per cent of the total state highway program estimated at $555,000,000 was financed other than by using the credit of the states or the general taxing power of the states.

7. That the financing of the state highway program through contributions from the counties is wrong in principle and will cost the public more in the end.

8. Interstate traffic is indicated for a number of representative states at upwards of 18 per cent of the total on the state highway system. The funds available from federal aid for the 1924 state highway program amounted to 16.5 per cent of the total. Considering only the funds available for the state highway program it appears there is a reasonable contribution from the federal government. Considering the whole program, state and local, the contribution from federal funds amounts to an average of not over 7.5 per cent to 8 per cent.

9. Principles of highway finance adopted by the American Association of State Highway Officials are supported by the evidence now available.

10. A greater percentage of state highway funds should be expended for more durable construction, and the state highway departments should be financed without recourse to county contributions.

11. The states must extend the supervision of their state highway departments over a larger mileage of local roads to insure their maintenance, thus preserving the investment. Unless this is done we are headed toward larger local expenditures for highway purposes or a depreciation of roads already built.

The discussion on highway relocation was lead off by a paper (which will be published in a later issue) by W. W. Crosby which was discussed by Ralph R. Benedict who took exception to the statement that quantity production tends to interfere with the proper study of highway relocation. He said, "In Illinois mass produc-

tion is an incentive to better location in that the locality benefited by the relocation or change in alignment will co-operate with the department and help to furnish the needed right-of-way with all possible dispatch. They realize that if this is not done, the roads in other localities will be built while they are awaiting the procuring of the necessary right-of-way. The question of the time needed for the study of location problems is only a matter of having sufficient engineers to make the preliminary surveys in advance of such a mass production program."

Making Contracting Pay—This always interesting question, to the contractor, was touched upon in four of the papers read before the construction division. One of these on estimating jobs is reserved for future publication in full. The items which should be looked into before bidding were enumerated by N. F. Helmers as follows: (1) Are funds available now? (2) Will payments be made monthly? (3) What is the retained percentage? (4) If cash is not available, what are the arrangements made and are they sound? (5) Are they legal in *every detail*? (6) Character of soil; (7) weather characteristics of country; (8) railway facilities to site; (9) available spurs; (10) desirability and expense of additional trackage; (11) existing roads, cost of maintenance; (12) cost of additional roads; (13) sources of fuel and water; (14) housing of men, camp locations; (15) local labor rates; (16) local aggregates; (17) study the plans and specifications. In conclusion: "Too many jobs, even very large ones, have been bid in either without any inspection or at least no real detailed inspection of those financially interested in the outcome. Any job which is to be bid must be considered in the light of a contract secured. A bidder should have in his mind *a way* to lay out and handle that particular job. If successful, he may modify or entirely change that way, but unless he bids with a feasible method of procedure in mind, that bid is not an intelligent proposal."

In keeping costs, W. R. Smith stressed the necessity of knowing costs as the work proceeded and of balancing cost data with the ledger. The general system employed by his firm was as follows:

"All bills against a particular contract, as fast as they are properly approved and classified, are entered on the cost sheet at the home office. The first column shown on the sheet is for date of invoice; the second, for name of the payee; the third, for quantity—wherever occurring, like tons of stone, or barrels of cement or feet of pipe. The quantities showing in the quantity column are used in securing unit costs during the progress of the work and the checking of the final estimate. The fourth column carries the total of invoice. Then follow columns headed to cover different items of cost desired, the sum of the classified items, of course, balancing the total, *and once a month the cost sheet total is balanced with the ledger.*

"A classification sheet, bearing the same cost headings as the cost book, must accompany all payrolls from the field to main office. The classified daily cost balances with payroll. The total classified payroll is entered on cost book—the same as invoices.

"On completion of the contract, the totals are brought to the bottom of the cost sheet; unit costs are worked out; unit receipts are shown against the cost; the total profit or loss of the job, and the percentage of profit or loss are computed. Everything of cost that can be shown against any one job is on this sheet. The cost sheet does not carry insurance, taxes, general repairs, depreciation, or salaries other than that of men detailed to a particular job. This overhead is worked into a percentage on business done."

The economies of winter contract letting were pointed out by J. H. Mullen. Enumerating the advantages to the contractor and the highway department in planning work and holding organizations Mr. Mullen said: "It would be useless to attempt an analysis of the cost saving that might be made by advancing the time of road lettings, for this is one of those intangible things which cannot be estimated in dollars; but, in the light of 16 years of experience in charge of work on 'both sides of the fence' I have no hesitancy in saying, that in the territory affected by cold weather, the letting of road contracts in the fall and winter instead of in spring and summer would result in much greater efficiency and economy."

Resurfacing and Maintenance—A cost analysis of snow removal based on a condition survey was presented by V. R. Burton. This was a highly detailed discussion and in succeeding issues the results of the condition survey and the cost analysis will be considered in separate articles. This investigation by Mr. Burton for the Michigan highway department is perhaps the most complete study ever made of the principles of snow removal and its cost trends and it requires close study of details which cannot be adequately summarized.

Maintenance as a field for contract work was reviewed by G. F. Schlesinger. Reviewing the character of maintenance work; including resurfacing, the general conclusion reached was: "It is not feasible to carry on many maintenance and repair operations under contract, principally because it is not practicable to formulate definite plans in advance of the work. While it is true that this applies to relative minor operations, in the aggregate they comprise a large share of the total maintenance expenditures. The proportion of maintenance work performed by contract in Ohio since 1917 varies from a minimum of 6 to a maximum of 26 in 1924. Using 20 per cent as an estimated average for the entire country the resurfacing and maintenance work to be let by contract in the United States in the next five years will amount to from $300,000,000 to $350,000,000.

Gang versus caretaker maintenance was summarized by W. H. Acheson in a paper reviewing the development of maintenance methods and the extensive replacement by machine operations of various old manual methods. In conclusion he said: "As I take it, caretaker maintenance means local patrolmen on definite beats; gangs are roustabouts, capable of taking care of any situation. My reactions and conclusions are that all patrol organizations must be augmented by gangs to work efficiently and secure results, for the reason that many times the work is too heavy for a small crew and it drags, which inconveniences the traveling public. This heavy maintenance crew is always capable of handling and manning all kinds of machinery and equipment.

Surface treatment of macadam and gravel roads was described in detail of J. N. Mackall. In introducing the specific methods Mr. Mackall said: "One of the greatest blunders which the highway official has made in the ad-

ministration of the highway affairs, by and large, is letting the public think of types of construction rather than of the road as a means of transportation. The public is in fact not at all interested in whether it rides from New York to Washington over a sheet asphalt pavement, over a concrete pavement, over a penetration or over a water bound macadam road. What it is interested in is riding over a road maintained in good serviceable condition every day in the year. If we can train the public mind to demand good roads, but not to demand good roads of a type, we will be doing them a great favor, and we will be putting the road building of the nation on a scientific basis on which it deserves to be.

"Ten years ago, for instance, it was the belief of the maintenance engineer that the important part of his annual work was the surface treatment of every mile of macadam road. An application consisted of somewhere between ¼ and ½ gal. to the square yard. It was applied to the surface in warm or cold weather, but it was applied when it was convenient for the highway department to apply it without any regard to whether the road needed it or was in condition to receive it. It was in this period that many roads were destroyed from too much surface treatment, but the greatest real losses came from the fact that in this period the public became utterly disgusted with surface treated macadam roads. The net result of this loss of patience of the public with surface treatment has been a loss to them of millions of dollars every year in the scrapping of good roads of a type which required surface treatment and the substituting for them of a type which did not require it. This result is still being felt today because it contributed so largely to the inability of the states to keep their highway program anything like apace with the demand from the automobile. To say that many, many miles of good macadam roads have been permitted to go to pieces either from lack of surface treatment or from an excess of surface treatment is a simple statement of facts; that many of these miles of road could have been saved and could have been in use today is my firm belief."

Construction Methods—Two papers on improper fine grading losses and on yard handling practice by C. J. Moritz and R. P. Petersen, respectively, call for charts and illustrations and will be condensed in succeeding issues. A paper by C. H. Powell on equipment standardization traced the progress made and urged extension of the movement. Discussing cement over-run R. E. O'Connor gave a very detailed discussion of the various conditions affecting this detail and named the following factors chiefly to be watched: (1) Checking shipments of material as to tonnage and quality; (2) storage of material and safeguarding against weather; (3) specification requirements for large amount of materials in storage ahead of construction; (4) number of times that aggregates are rehandled, entailing loss with each handling; (5) measurement of aggregate, bulking action of sand, variation of voids in coarse aggregate; (6) number of handlings of cement with loss for each handling and (7) method of delivery of batched material to mixer and effect on condition of prepared subgrade.

Trends in Pavement Structure—Two papers, one by H. M. Rex on asphalt pavements and one by H. E. Surman on concrete pavements traced the trends in road and pavement design and structure. In general, the same features were noted as were mentioned in *Engineering News-Record*, Jan. 7, 1926, p. 4. Certain special details calling for illustration will be noted in future issues.

Contractual Relations—General papers on the relations of engineer and contractor were presented by R. C. Marshall, C. M. Babcock and George B. Walbridge. These were extended discussions, not susceptible to condensation, and were chiefly notable for the fair attitude, of both engineers and contractors on controversial questions. Their chief thought was one of promise for better contractual relations as time goes on and of appreciation of progress already accomplished.

Powdered Coal for the Des Moines Water-Works Boilers

FOR the first time in this country powdered coal is being used to fire boilers in a water-works pumping station. The Des Moines municipal water plant claims the distinction. The chief mechanical engineer of the plant, G. A. Conrath, has devised and applied for patents on pulverizing and feeding apparatus.

The coal pulverizer which resembles a steam turbine in construction has movable and stationary blades which retard the passage of the powdered coal. It is a 6-stage, motor-driven unit revolving at 1,750 r.p.m. and pulverizing the coal to a fineness so that 90 per cent will pass through a 200-mesh screen. Air preheated by the gases in the breeching is carried in ducts to the pulverizing machine to dry out the coal and pass with it into the fire box. Additional air is admitted into the furnace to complete combustion as the coal becomes gasified. The machine is automatically controlled by the steam pressure. As the stoker fired furnaces were not suitable for powdered coal, an enlarged furnace was built 18 ft. deep from the water tubes to the bottom of the furnace, giving about 0.5 cu.ft. of furnace volume per square foot of steam-making surface. Whereas former temperatures in the furnace were 1,800 to 2,000 deg. F., the present temperatures usually reach 3,000 deg.

Installation cost of the machine including the enlarged furnace was $2,500. It is estimated by C. S. Denman, manager, that the annual saving will net $7,500. So far, only one boiler has been changed over, but the other three will be equipped for powdered coal upon completion of the tests on the initial unit. The total rated capacity of the plant is 1,292 hp. The pulverizer has sufficient capacity to care for the four boilers.

Railway Construction in 1925

Construction of new railway lines and extensions during 1925 aggregated 644 miles, according to statistics of the *Railway Age*. This is the highest since the low point of 314 miles in 1920. Florida and Texas head the list with 99 and 96.72 miles, respectively; Oklahoma comes third with only 58.8 miles. In Canada, the new lines totaled 414 miles; and Mexico built about 132 miles. Railways abandoned in the United States aggregated 606 miles, the longest individual line being 76.83 miles of the Manistee & Northeastern Ry. The above figures are for steam railways. Extensions of electric interurban lines and street railways totaled 109 and 181 miles, respectively, according to statistics published by the *Electric Railway Journal*. For Canada, these figures were 3 and 46.6 miles respectively.

Federal Road System Started in El Salvador

Trunk Line System of 800 Miles Financed and Put Under Contract by Progressive Central American State

By R. C. Hardman
Chief Engineer, R. W. Hebard & Co., Inc., & René Keilhauer, San Salvador, Central America

A PROGRAM of highway development has recently been begun by the Republic of El Salvador which will, upon completion, provide complete intercommunication and also outlets to the adjoining republics of Guatemala and Honduras. El Salvador at present is very meagerly supplied with highways although unimproved earth roads form a network over the more important parts. These, however, are passable only to ox-carts throughout most of the year.

Under the leadership of the President, Dr. Alfonso Quinonez Molina, nationwide propaganda for good roads has been carried on for some time past. This has consisted of postal cancellations on all mail matter and large signboards. At the recent session of the National Assembly a law was passed providing for a special tax, based upon income, to provide funds for the work, which is estimated will furnish some $750,000 per year. Additional financing to further the speed of the work is also contemplated.

The program provides for the construction of two major divisions of highways, namely: National and Departmental. The national highways will connect all the principal cities and ports, open up new sections and furnish access to the frontiers, while the departmental roads will serve as feeders.

The national highways will consist of between 1,200 and 1,300 kilometers and a contract has been entered into with R. W. Hebard & Co., Inc. & René Keilhauer for the location, design and construction of the work. This company has, in addition, contracts for the complete sanitation of the capital city, San Salvador, and the port of La Libertad, amounting to nearly $5,000,000, making the total amount of all contracts around $20,000,000.

There will be three classes of national highways. The first class will be of either asphalt or concrete and the other two of waterbound macadam with an oiled surface. Other characteristics, which are provided for in the contract are as follows:

Class	Max. Grade Per Cent	Minimum Curve— Plains Meters	Mountains Meters	Sight Horizontal Curves Meters	Distance Vertical Curves Meters
1	6	162	58	60	86
2	8	162	58	60	86
3	8	80	30	40	45

Salvador has an area of 13,000 sq.mi. and a population of some 1,500,000, which makes it the most densely populated country in the American continents. Its principal exports are coffee and sugar, the coffee crop alone represents an annual amount of from twenty to twenty-five millions of dollars.

Topographically the republic is generally mountainous, ranging in elevation from sea level to nearly 8,000 ft., with a large number of volcanic cones, many of them active, making location and construction difficult. Further difficulties will be encountered in the scarcity of suitable rock and sand of which the country is peculiarly lacking. Although the rainfall is heavy, water is also relatively scarce and difficult to procure during the long dry season, an item which may conceivably affect the location to some extent.

PROPOSED PRIMARY AND SECONDARY ROAD SYSTEM FOR EL SALVADOR, CENTRAL AMERICA

Parties are at present being organized for the survey work, which has already been started by one party made up from locally available personnel. The general administrative and technical work is being done by the present staff of the company, which has been operating in San Salvador for the past two years.

The company is represented locally by Col. M. E. Gilmore, general manager, Mr. Alfred Schaff, general superintendent, and the writer as chief engineer. The work comes under the jurisdiction of the Ministro de Fomento, Doctor Marcos A. Letona, the technical inspector for the government being don Louis Fleury.

Bearing-Power Tests on Deep Caisson Foundations

American Insurance Union Building in Columbus Founded on Hard Clay 90 Ft. Below Ground Where Borings Indicated Limestone—Clay Strength Measured, Bearing Areas Proportioned Accordingly

By Roger L. Waring
Architectural Superintendent for C. Howard Crane, Architect, Detroit Mich.

AND

Clyde T. Morris
Consulting Engineer, Columbus, Ohio

THE NEW home office building of the American Insurance Union in Columbus, Ohio, will when completed be 555 ft. 5½ in. tall above the curb, which, by the way, is the exact height of the Washington Monument. The building is now under construction. It is of the tower type, 37 stories in height, with two flanking wings each 18 stories in height, running north and east, respectively, from the tower, forming an ell. See Fig. 1. In the angle formed by these wings is being built a theater, the height of which will be equal to about seven stories. It is the purpose of this article to describe some of the problems encountered in designing and constructing the foundations for this building.

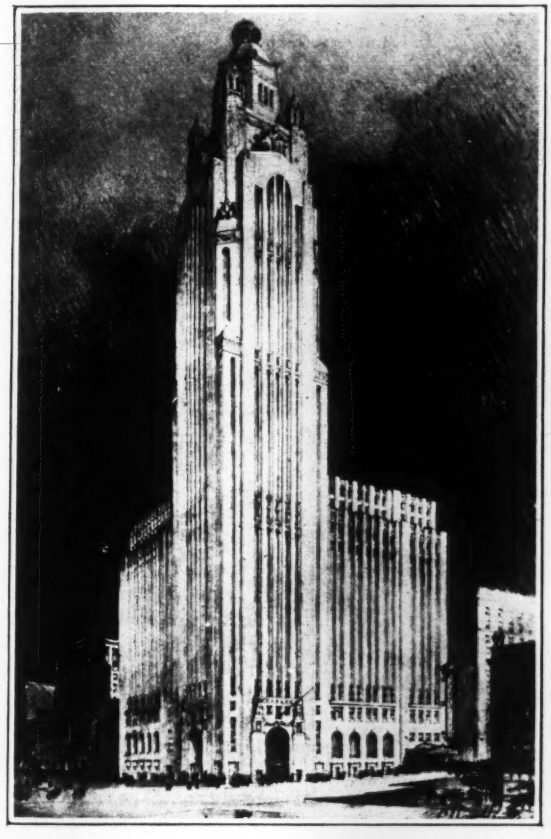


FIG. 1—AMERICAN INSURANCE UNION BUILDING, COLUMBUS, AS IT WILL APPEAR WHEN COMPLETED

At first it was proposed to use caissons under the tower and wings and spread footings under the theater, but finally, in order to obviate unequal settlements between the theater and the rest of the building, caissons under both sections were adopted.

The building is located about 500 ft. east of the Scioto River, and curb level at the building is about 45 ft. above the river level. The river at this point flows south along the eastern edge of a wide pre-glacial valley, through a deep alluvial deposit of sand and gravel. Preliminary test borings were started Aug. 13, 1924. Four holes were sunk to rock, and the average record of these borings is as follows:

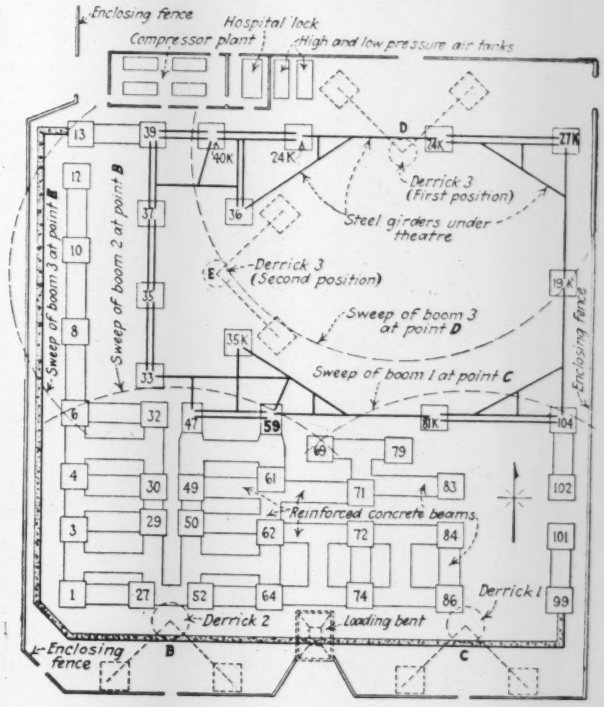


FIG. 2—LAYOUT, FOUNDATION CAISSONS AND DERRICKS

AVERAGE BORING RECORD

Elevations	Soil	Depth
102 (curb level)		
102 to 82	Sand and gravel	20
82 to 72	Sand and blue clay	10
72 to 62	Clay, sand and gravel	10
60	Water line	..
62 to 32	Waterbearing sand and gravel	30
32 to 22	Fine sand and gravel	10
22 to 2	Blue clay and hardpan	20
2 to 8	Blue Niagara limestone	10

The elevation of bedrock as indicated by these borings was about the same as that which had been found in drilling wells at the state penitentiary, about half a mile northwest of and somewhat below that found in a well drilled at the State House, about 600 yd. southeast of the site, so the design of the caissons was made on the assumption of finding rock at this elevation.

As will be seen from the record of the borings, there was about 38 ft. of sand and gravel below the water line and pneumatic caissons were therefore deemed the best solution of the foundation problem. When the caissons were sunk, an accurate record of the soil strata was obtained, which checked very closely with that of

the test borings except at the bottom, about which more will be said later.

The accompanying foundation plan, Fig. 2, and the photograph Fig. 3 show the locations of the caissons and the foundation girders resting upon them. To support the 125 columns, a mat of girders spanning from caisson to caisson was designed. Under the tower and wings, the loads being heavy and the spans between caissons correspondingly short, reinforced-concrete beams were used, while under the theater the lighter loads permitted wider spacing of the caissons, making longer spans for the beams, and consequently steel girders encased in concrete were deemed more economical.

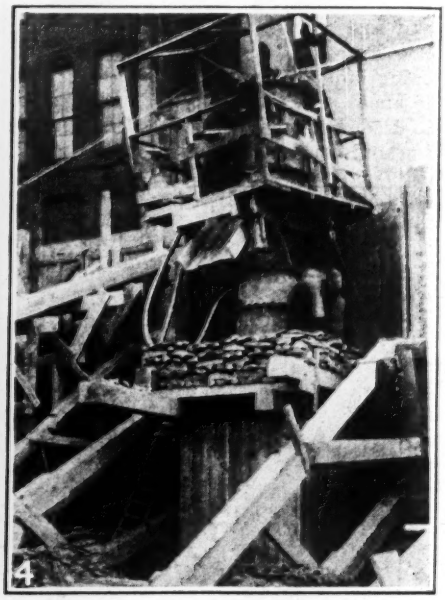
The reinforced-concrete girders under the tower and wings support as high as 1,000 tons each, which, concentrated as they are at midspan, call for considerable width and depth. In order to reduce the size of these girders as much as possible, a rich mixture of concrete (averaging about 1:1:2) was used, which permitted increased unit stresses. Even then, some of the girders were 8 ft. x 8 ft. in cross-section, carrying a corresponding amount of reinforcing steel. In the design of these girders, no allowance was made for the support given them by bearing on the soil. All their load was figured as being carried by the caissons.

It was thought that the "blue Niagara limestone" found by the borings at El. +2 would support as much load as the concrete of the caissons, and therefore the caissons were designed for a unit pressure on the base of 35 tons per sq.ft. No allowance was made for skin friction in the calculations, but the entire load at the top of the caisson plus the weight of the caisson shaft was taken as the weight brought to bearing on the rock. The sizes as thus figured ranged from 6½ ft. to 9 ft. square.

On Dec. 27, 1924, the site having been cleared and the basement excavation completed, the first cutting edge was set, and actual work on the caissons was begun. The steel cutting edge was connected to a steel framework covering the working chamber and encased in concrete. The caisson shafts were square and battered about 1 in. in 13 ft. in each direction; they were built of reinforced concrete and had a 3-ft. circular shaft down the middle. After the sinking was complete, the working chamber and shaft were filled with concrete.

Four belt-driven air compressors, each receiving its power from a 500-hp. motor, furnished the compressed air. One was used for the high-pressure line to the jackhammers, and the other three for the low-pressure lines to the air locks. This plant was located at the northwest corner of the property (Fig. 2).

The caissons under the tower and east wing were served by two 90-ft. boom stiff-leg steel derricks, located on the south side of the excavation. The remainder of the job was served by a wooden stiff-leg derrick with 80-ft. boom, located on the north bank.



FIGS. 3 AND 4—GENERAL VIEW OF THE FOUNDATION WORK, AND TOP OF A WEIGHTED CAISSON

The batter of the sides of the caissons made it a little more difficult to keep them plumb, and perhaps resulted in a little more air leakage, but it proved to be a very wise expedient, on account of the difficulty in sinking as soon as the clay stratum was reached, at about El. 22. This stratum started at the top as a brown plastic clay and gradually graded into a harder blue clay. As the soft brown clay gave way to the harder material, horizontal laminations appeared which became more noticeable as the sinking progressed, until at El. +2 the material had become so hard that it resembled shale. This clay built up a tremendous surface friction around the caisson walls, so that pig iron had to be piled on the shafts to sink them, as shown in Fig. 4, in some cases over 300 tons. In one case, although it was loaded to the limit, the caisson could not be sent home and it was necessary to dig down to the required elevation below the cutting edge, fill the excavation with concrete, and cut off the top of the caisson to the required height.

Rock Not Found—When the first caisson reached El. +2, the limestone which the test borings indicated was not found. Numerous concretions were found in the hard clay, which increased in number as the sinking

proceeded, until in places they assumed the form of a layer of rock ten or twelve inches in thickness and larger in area than the bottom of the caisson. It is probable that something of this kind is what was encountered and reported as "blue Niagara limestone" in the test borings.

The caissons were designed, as noted above, to bear on bedrock, so when rock was not found at +2, the cutting edge was sunk deeper until the excavation was carried down to —10.75; this was as far as it was practicable to sink the caisson shaft. A 4-ft. hole was dug 10 ft. farther, to El. —21, or 121 ft. below curb grade, searching for limestone, but only the shale-like laminated clay could be found. We were now confronted with the problem of going still deeper—we knew not how far—or stopping on the laminated clay or hardpan.

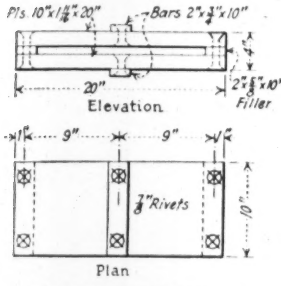


FIG. 5.—TEST SPRING

This laminated clay was almost as difficult and expensive to excavate as rock. One or two feet of sinking in eight hours was the best that could be done at El. —10 to —12. To go deeper meant additional excavation at an unusual and increasing cost, using more pig iron to force the caissons down, and removing the air locks and lengthening the caisson shafts. In view of the above it was considered advisable to stop the cutting edge at —12 and bell out the working chamber below the cutting edge until sufficient area was secured to carry the load at a safe pressure on the laminated clay.

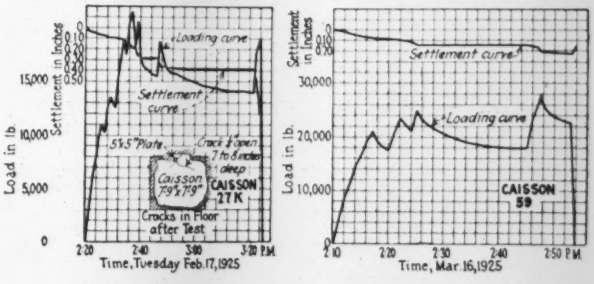
FIG. 6—BEARING-POWER TEST

Bearing Power of Clay Tested—In order to determine the safe bearing power of the soil, pressure tests were made on the soil at the bottom of nine of the caissons, and a representative sample of the material at the bottom of every caisson was cut into cubical form and tested in an ordinary compression machine. The latter tests were made in order to establish a relation between the strength of the material in an unconfined cube and when confined in place in the earth, which could be used in determining the safe load on caissons. The cube tests were easily and quickly made, while it required about three hours and considerable expense to put on a pressure test at the bottom of a caisson.

Test Apparatus—The apparatus used for the pressure tests at the bottom of the caissons consisted of a calibrated spring (Fig. 5) resting on a bearing plate 5 in. square on the soil. On this spring was placed a 25-ton ball-bearing screw jack which in turn thrust against the under side of the cutting edge of the caisson. The load on the spring was read by means of Ames dials on the two sides; by repeated tests in a compression machine this method of reading load was found to be accurate within one per cent. The capacity of the spring was limited by the elastic limit of the material to about 30,000 lb. The spring consisted of two steel plates 10x1¼ in., 20 in. long, separated at the ends by 2x⅜-in. straps, and the load was applied through 2x⅜-in. straps riveted to the middle of the leaves. The whole apparatus in place is shown in the photograph Fig. 6.

The settling of the bearing plate into the soil under test was measured from a fine steel wire stretched in front of a celluloid scale on a mirror attached to the lower leaf of the spring. This scale could be read to hundredths of an inch.

The load was applied in increments of about 2,500 lb.



FIGS. 7 AND 8—TYPICAL SETTLEMENT RECORDS FROM BEARING-POWER TESTS

(= 100 lb. per sq.in.) until a settlement of about ⅛ in. was obtained. It was then allowed to rest for a period of fifteen to twenty minutes, during which rest period frequent readings were taken to determine the yielding under the load. After the rest period the load was run up until the material gave way or until the capacity of the spring was reached. Figs. 7 and 8 show typical records. After the tests, the floor was examined for cracks. Excessive settlement of the bearing plate was always accompanied by bulging and cracking of the floor around it.

As noted above, 8-in. specimen cubes were taken from all caissons and tested in a compression machine. These tests were performed by Prof. J. R. Shank at Ohio State University, as soon as possible after removing the specimen from the ground. In order to keep the specimen from drying out during transportation to the testing machine, it was kept in a tightly covered tin can. The failure of these cubes resembled the failure of concrete specimens of the same size, as is shown by the photograph Fig. 9.

The following table gives the results of the nine bearing tests in the caissons and of the cubes taken from the same caissons:

RESULTS OF BEARING AND CUBE TESTS

Test No.	Caisson No.	Load in tons per sq.ft. Bearing Test	Load in tons per sq.ft. Cube Tests	Ratio Cube to Bearing per Cent
1	74	72	17.3	24.1
2	27K	43.8	16.9	38.6
3	27K	53.9	17.2	31.9
4	81K	76.6	24.0	31.3
5	59K	80.3	18.4	22.9
6	1	68.6	27.3	39.8
7	6	75.0	22.9	30.5
8	12	71.0	22.8	32.1
9	104K	84.5	23.7	28.1
			Average	31.0

The bearing power of the soil when confined, as it is when the caisson is finally sealed, is no doubt greatly in excess of the pressures sustained under the 5x5-in.

bearing plate in the bearing tests. Therefore it was decided to adopt as a safe working load a pressure not to exceed 35 per cent of the load sustained under the bearing test, with a maximum of 25 tons per sq.ft. For those caissons under which no bearing test was taken the strength of the cubes was used as a guide in selecting the safe bearing unit. It is believed that these values give a factor of safety of at least five.

The material resembles a gray colored soft shale, and when taken from the ground does not contain an excess of moisture. Upon exposure to the air the laminations open up, and in water the material will slack down. The specimens were sawed into shape with an ordinary hand saw. The material contains

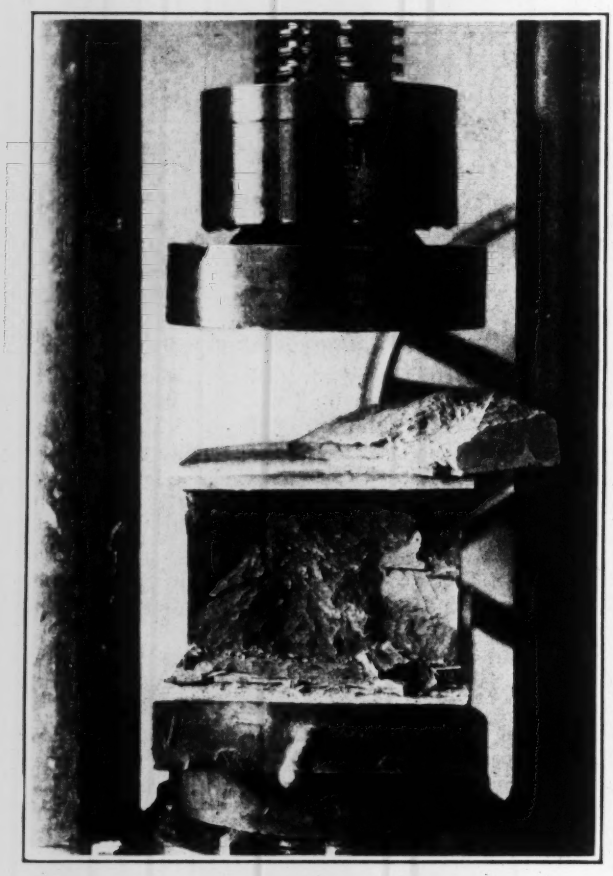


FIG. 9—CUBE TEST OF HARD CLAY

numerous concretions and pyrite modules from the size of a walnut to a foot or more in diameter.

It might be interesting to note that the very excellent photograph of the apparatus in place at the bottom of the caisson, Fig. 6, was taken with an ordinary 3¼x4¼-in. folding pocket camera on an ordinary film purchased at the corner drug store, and with a 3½-min. exposure by the light of a 500-watt incandescent bulb.

C. Howard Crane, of Detroit, is the architect for the building, and A. E. Yokom, Detroit, is the structural engineer. Roger L. Waring is field superintendent for the architect; J. J. Morgan, of Columbus, is consulting engineer on the structural work; Clyde T. Morris, of Columbus, is consulting engineer on the foundations. John Gill & Sons, of Cleveland, are the contractors for the building.

$101,028,000 Needed for Sewerage and Treatment at Detroit

City Engineer Advises $61,428,000 for Collection and Committee $39,600,000 for Clarification and Disinfection

SEWERAGE and sewage treatment construction by the city of Detroit, Mich., to be executed within seven years at an estimated total cost of $101,028,000, has been recommended. Of this sum, $61,428,000 is for sewerage extensions into large areas now without sewerage facilities and for reinforcing the existing systems, and $39,600,000 is for intercepting sewers, pumping stations, and a single sewage treatment plant to serve the entire city as briefly outlined in our issue of Dec. 24, 1925, p. 1048. The last-named sum covers the recommendations of the Special Committee on Sewage Disposal created early in 1925 and the first-named sum is the total of the items comprising the extension and reinforcement of the collecting system as recommended by Perry A. Fellows, city engineer of Detroit. The projects have been approved by John W. Reid, commissioner of public works, and forwarded to the City Council with the recommendation that $3,295,000 to start work on the projects be made available immediately. The general plan of the main sewage disposal project, as recommended by the committee, was formulated by three consulting engineers employed by the committee: Harrison P. Eddy, Boston, Prof. John H. Gregory, Baltimore, and Clarence Hubbell, formerly city engineer of Detroit. The members of the committee were: Chairman, A. C. Marshall, vice-president and general manager, Detroit Edison Co.; Perry A. Fellows, city engineer and secretary of the committee; George R. Cooke, contractor; Francis C. McMath, president and chief engineer, Canadian Bridge Co.; and Lewis C. Rogers, Solvay Process Company.

Before taking up the recommendations of the committee and the consulting engineers, a digest will be given of the report of City Engineer Fellows on what for brevity will be called the proposed collecting system, noting first, however, that Commissioner Reid states that of 140 sq. miles within the present limits of Detroit, about 60 sq. miles have no sewerage service.

Mr. Fellows urges that provision should be made for not only the present area of 140 sq. miles within the city limits, but also outside territory likely to be annexed. He suggests that special agreement should be made with neighboring municipalities for use of the

ESTIMATED FIRST AND ANNUAL COST OF SEWAGE DISPOSAL AND TREATMENT WORKS FOR DETROIT, MICH.

Intercepting sewers (for 3,500,000 population)		
Detroit River	$12,750,000	
Baby Creek	1,470,000	
River Rouge (to Emerson Road)	1,280,000	
		$15,600,000
River Rouge pumping station (for 2,400,000 population		2,250,000
Sewage treatment plant (for population of 2,400,000 but including land for 3,500,000)		18,150,000
Contingencies and engineering, 10 per cent		3,600,000
Total estimated cost of construction		$39,600,000
Annual charges (sewage-works and sewage-pumping, not including existing Fairview pumping station but including interest and sinking fund)		
Operation:		
Sewage pumping	$312,000	
Sewage treatment	618,000	
		930,000
Interest and sinking fund: $39,600,000 at 6 per cent		2,370,000
Total estimated annual charges		$3,300,000

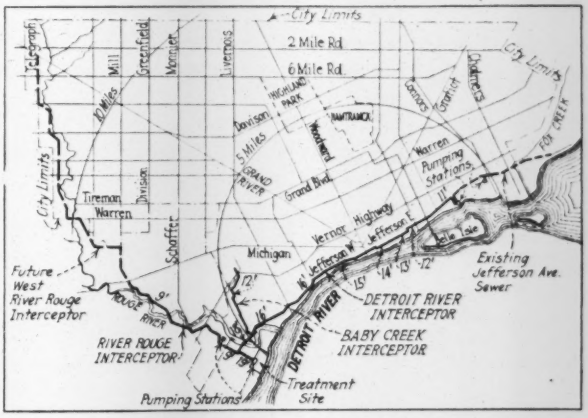
Detroit sewerage facilities, to avoid duplicate construction and unnecessary expense in the outlying districts. Combined sewers throughout practically the entire area are contemplated. These, Mr. Fellows states, should be designed large enough so that they will not be overcharged or cause floods oftener than once in 10 years. The estimated cost of this work as planned by Mr. Fellows is $61,428,000 of which $15,580,000 is needed during the first year. Approximately 220 miles of public sewers are contemplated in this program.

Main Disposal and Treatment System—The consulting engineers to the committee advised intercepting sewers along the Detroit and Rouge Rivers and Baby Creek, with only a portion of the River Rouge interceptor included in the estimated cost; changes in the existing Fairview sewage pumping station near the upper end of the Detroit River interceptor; a pumping station and a sewage treatment plant at the intersection of River Rouge with the Detroit River below the present city limits on a site which it is advised should comprise 200 acres. The three intercepting sewers and land for the sewage-works should be sufficient for a population of 3,500,000, as would also the land for the proposed site; but the River Rouge pumping station and also the sewage treatment works to be built at the outset and within the total estimated cost of $39,600,000 would be designed to serve only 2,400,000 population. It is stated in the engineers' report that Detroit now has a population of 1,500,000 and is growing at the rate of 100,000 a year; that there are now 1,647 miles of sewer within the city limits; and that the average dry-weather flow, including that from Highland Park and Hamtramck, is 225 m.g.d. Practically all the sewers receive both sewage and storm water, and it has been the practice to inclose natural water courses.

Method of Treatment Proposed—The proposed method of treatment is summarized in the report of the consulting engineers as follows: "The sewage treatment plant to consist of skimming-detritus plant and an Imhoff tank sedimentation-sludge digestion plant; suitable equipment for disinfection; conduit to provide proper period of contact for disinfection; and submerged outlet structure together with the necessary land and structures adequate for dewatering and disposal of sludge." A multiple outlet system into the Detroit River is proposed. Bar screens and grit chambers are also proposed.

General Considerations as to Treatment—The report of the Sewage Treatment Committee states that Detroit is compelled to purify its sewage in order to comply with the international treaty with Great Britain, with the laws of Michigan, and with the requirements of an awakened civic consciousness as well as by the example of cities more progressive than Detroit has yet been. Reference is made to the treaty of Great Britain dated Jan. 11, 1909, in which it was agreed that the boundary waters between the United States and Canada would not be polluted on either side to the injury of health or property. Mention is also made of the fact that an investigation of sewage treatment needs in Detroit was made by or for the International Joint Commission in 1913, but that action in accordance with the resulting recommendation was deferred on account of the war.

Practically the entire sewage of Detroit is discharged into the Detroit River between Connors Creek and the River Rouge, a distance of 10 miles. Of 50 sewer outlets, four discharge into the Detroit River direct, one into Baby Creek, and five into the River Rouge. The Detroit River has a flow of 150,000 sec.-ft. with a velocity of 2½ sec.-ft. or 1.7 mi. per hr. Along the waterfront, the river is from ½ to 1 mi. wide and upwards of 30 ft. deep. The international boundary line is about in the middle of the river except that it passes to the southward of Belle Isle. The public water supply of Detroit is taken from the Detroit River a quarter of a mile offshore opposite the upper end of Belle Isle. Where the Detroit River emerges from Lake St. Clair its water is clear, with "slight contamination" from ships, land drainage, and sewage from different communities above Detroit. Sewage in increasing amount is discharged into the Detroit River as it passes along



PROPOSED INTERCEPTING SEWERS, PUMPING STATIONS AND SEWAGE-WORKS LOCATION, DETROIT, MICH.

Of the three proposed intercepting sewers, the largest one along the Detroit River will begin at the existing Fairview pumping station, an intercepting sewer having been built from that point upstream as shown. The upper end of the proposed Rouge River interceptor is not included in the cost estimate, but the Baby Creek interceptor is included. The intercepting sewers would serve, altogether, 3,500,000 population and the main pumping station and the sewage-works, 2,400,000 population.

the waterfront of Detroit and additional polluting matter is contributed by the River Rouge, besides all of which industrial wastes reach the Detroit River. Beginning at the mouth of Connor's Creek, the water is said to be greatly polluted near the shore. The committee's report also states that in warm weather there is a sewage odor along the waterfront, especially at and immediately below creek and sewer outlets. Besides the odors given off by the decomposition of deposits on the bed of the stream, the sewage of Detroit causes offense to the eye through light floating matters, including oil and grease, the latter affecting not only the water supply but also bathing beaches. The latter have been closed by the local Board of Health on account of pollution. The committee report states that typhoid has been traced to the use of these beaches and that the pollution of the city water supply by its sewage is serious.

The proposed main disposal and treatment works will be large enough to take care of the sewage of communities above Detroit for some time to come, and the sewage of some communities down the river from the proposed treatment works could also be cared for by the latter. The proposed site for the treatment works is large enough to permit expansion of nearly 50 per cent in the plant itself and still have room for planting and park development to isolate the sewage works from the neighborhood and make an attractive development generally.

Earthquake Expectancy in California

Authoritative Conclusions from Earthquake History and Tectonic Disturbances—Hypothesis of Landward Pressure and Release of Strain—No Major Shock Expected Along North Coast for Some Decades

By Henry D. Dewell
Consulting Engineer, San Francisco

IMMEDIATELY after the earthquake of 1906 in northern California, commonly known as the San Francisco earthquake, American engineers became interested in the effect of seismic disturbances on structures, particularly buildings. At that time reinforced-concrete construction for buildings was in its infancy, and much discussion immediately ensued regarding the relative merits of structural-steel frames as compared to reinforced-concrete for resistance to earthquakes. Unfortunately San Francisco in 1906 had no reinforced-concrete buildings, due largely to the political influence of the bricklayer's unions. After a few years the general interest in earthquake-resistant construction waned, but it was renewed to some extent by the Japanese earthquakes of 1923. Comparatively few American engineers had the opportunity of witnessing the effect on buildings of the Japanese shock; most of us have had to be content with the reports of other engineers. The St. Lawrence earthquake of February, 1925, followed by those in Montana and the Santa Barbara disaster have again centered interest on the general subject of the occurrence of earthquakes and the proper construction for resistance to them.

Building to resist earthquake shock is coming to be demanded of the engineer in regions generally recognized as actively seismic, such as California, and may in time be demanded even in regions usually quiet. A general survey of the earthquake outlook is therefore important. Mr. Dewell, who has kept in close touch with the scientific study of California earthquake history, summarizes the present state of knowledge of the subject for that state, as a preliminary to outlining principles and methods of earthquake-resistant construction in an article to follow within a few weeks.—Editor.

The California earthquake of 1906 was studied minutely, not only from the standpoint of damage to structures, but also from the purely scientific view. Geologists and seismologists have, particularly since 1906, continued an intensive study of seismic disturbances in California, covering the probable causes and history of earthquakes and the possibility of predicting them. In particular, the Seismological Society of America, organized in 1906, with headquarters in California, in co-operation with the Carnegie Institution, has been working steadily to obtain as much information as possible on the subject; to make the public, particularly of California, realize the necessity for frankly admitting the probability of future earthquakes and the importance of building properly to resist them. In this commendable work the society is meeting with considerable success. Not only are engineers, architects and contractors evincing a real and definite interest in earthquake-resistant construction, but the general public also is being aroused.

Two California cities, Palo Alto and Santa Barbara, are in the process of revising their building ordinances to include special provisions covering proper design against earthquake shock. Insurance companies are actively studying the earthquake risk and are seeking to place their obligations upon a more logical basis than has heretofore existed. Coincident with this study, and since the Santa Barbara disaster, the cost of earthquake insurance has increased very materially, and individual buildings are being rated as to earthquake risk. Financial houses underwriting the cost of construction are now requiring earthquake insurance on properties on which money is loaned.

All in all, the subjects of earthquake risk and earthquake-resistant construction have quite suddenly become of major importance. The two subjects are so closely allied that the engineer who designs the structural features of buildings should be informed as much on the one subject as on the other.

As stated above, earthquake conditions in California have received intensive study. The results of this study to date are of such interest that an attempt will be made in the present article to outline its major deductions on earthquake risk in California. No claim for originality is made by the writer for the material here presented; on the contrary he seeks to set forth certain evidence collected by other which has appealed to him as logical and reasonable. In particular, the writer expresses his thanks to Dr. Bailey Willis, president of the Seismological Society of America, for permission to make use of his material. Those interested in this subject will find much of value in the bulletins of this society, published at Stanford University.

The studies represent a tremendous advance over the ancient belief that the earthquake was a visitation of an angry deity, and the hardly less futile modern conception that man can do nothing to protect himself against destruction by earthquakes and perforce had best forget them.

Earthquake Types—Earthquakes are divided into two classes: (1) Volcanic and (2) tectonic; in other words, earthquakes associated with volcanic activity, and earthquakes resulting from slips along fault planes. These fault planes divide the earth's crust into "blocks," hence the aptness of the adjective with the Greek root signifying carpentry. Probably ninety per cent of the earthquakes of the present geologic era, and certainly all of those in California, have been of the tectonic type.

Intensity of Shocks—Earthquake intensities are indicated by reference to some recognized scale, such as the well-known Rossi-Forel scale, which grades the intensities from I to X. Such scales have not an absolute basis of measurement; the intensity is established by damage done to buildings. In the Rossi-Forel scale,

only earthquakes of intensities above VII are sufficient to cause material damage to buildings. The San Francisco earthquake of 1906 was from IX to X in intensity; the Santa Barbara earthquake of June, 1925, was from VIII to IX, possibly exceeding this at certain points. It is important to note that these numerals are proportional to logarithms of intensities, hence the difference in intensity between IX and X is much greater than between VIII and IX.

California Earthquake History—Earthquake history in California begins with the traditions of the Indians and carries through the records of the Spanish padres, the early periodicals and the diaries of the first settlers, the later reports of the regular newspapers, to the present scientific record. The period thus covered is from 1750 to date, or 175 years. The records of different shocks are not of equal value; indeed, from 1906 to 1914 there was an intentional suppression of information regarding earthquakes in California. It is also true that, in the past, different localities did not keep equally complete records; Southern California has been deficient in this respect as compared to Northern California. From July 1, 1915, to June 30, 1924, the Weather Bureau assembled through its station observers the most complete list of earthquake shocks in the United States ever secured. Unfortunately Congress in transferring the seismological service to the Coast and Geodetic Survey made no appropriation of funds, and the record has lapsed during the year and a half of greatest interest to the whole country.

From the standpoint of earthquake history California may be divided into five provinces, roughly defined thus:

(1)	Southern California,	vigorously active
(2)	Northern Coast Ranges,	vigorously active
(3)	Sierra Nevada,	vigorously active
(4)	Southern Great Valley,	secondarily active
(5)	Northern Great Valley,	secondarily active

The first three divisions are the most important from the standpoint of earthquake activity, since in these occur the faults which have been particularly active. The first two provinces, containing the more important cities, are consequently of chief interest from the standpoint of risk.

The Southern California province may be defined as including the area bounded on the south by Mexico and Lower California, on the west by the Pacific Ocean, on the east by the westerly line of the San Joaquin Valley, and on the north by the latitude of Monterey Bay. The Northern California province includes the Coast Ranges from the latitude of Monterey as far north as Eureka. These provinces are outlined on the accompanying fault map. Through these two districts extends the great San Andreas fault, which has a total known length of some 600 miles. Historically, no single shock has as yet affected both the Northern and Southern provinces of California simultaneously, with disastrous violence.

In the Sierra Nevada province, violent earthquakes have occurred only along the eastern border. The district contains a great fault system which is shown on the map. This fault is from Honey Lake southward along the valley east of the Sierras to the southern end of that range, where it bends southwestward to join the San Andreas fault near Gorman.

Frequency of Shocks—A study of the earthquake record in California indicates that, taking the state as a whole, a moderately severe earthquake may be expected somewhere in the state about every five years. Earthquakes which reach the intensity of X have occurred in the Coast Ranges at intervals of approximately thirty years. The period between these heaviest shocks appears to be longer in the southern district than in the northern. The last great earthquake in the southern district was in 1857, the Fort Tejon earthquake. The San Andreas fault from Yuma to San Benito, the San Gabriel fault from San Bernardino to Santa Barbara and beyond, and the San Diego-Inglewood fault along the coast were more or less vigorously active at this time. The last great earthquake in the northern district was the San Francisco earthquake of 1906, violently active along the San Andreas fault and subsidiary faults

EARTHQUAKE PROVINCES OF CALIFORNIA
The known main fault lines are shown by heavy dash lines.

from San Benito to Punta Arenas, a distance of 180 miles.

It has been said that the historical records indicate that these earthquakes occur in groups with intervals of quiescence between each group. Great disastrous shocks appear to be preceded by severe local shocks at intervals of from two to three years, with a subsequent marked cessation of seismic activity preceding the major shock. The great or "relieving" shock is then followed by innumerable after-shocks, which may continue for a year or more.

Summarizing the historical records, then, of the northern and southern California districts, the statement may be made that, based on the earthquake record since 1906, the northern district would seem to be safe against a major shock for twenty to thirty years from now. Recent seismic activity of a minor nature would indicate that the stresses are now beginning to accumulate along the San Andreas fault. In the southern district there has been no violent slipping of the San Andreas fault since 1857, a period of 68 years. Beginning in 1915 there have been a number of severe shocks at different localities: in 1915, 1916, 1917, 1918, 1920,

1922, 1923, and finally (Santa Barbara) in 1925. Possibly, but not probably, this series of shocks has dissipated the accumulated energy. From the standpoint of historical records the evidence would seem to indicate that a major disturbance along the southern portion of the San Andreas fault is probable in the near future.

That there is a tremendous pressure being exerted along the California coast from the south or southwest toward the north or northeast is recognized by seismologists. As evidence of the existent pressure the spalling of rock with a force sufficient to throw fragments with violence, was noted in the boring of a tunnel recently in the Southern California district.

Surface Movements—Efforts have been made to observe the effects of pressure by determining changes of the latitude of certain well established points, but the results so far are inconclusive. Precise measurements by the Coast and Geodetic Survey of the distances between triangulation points at intervals from 1857 to 1923 have demonstrated movements varying from 5 to 24 ft. with reference to two triangulation stations located at the crest of the Sierra Nevadas, which are not yet known to have moved with reference to points further east. The displacements in California bear out the theory of upbuilding pressure acting on the coast from the southwest, and of the release of strain at the time of a major shock, by indicating not only an actually northerly creep of the points throughout the years but an actual southward slipping since the 1906 earthquake, and within the range of its effect.

On the other hand, similar precise measurements made in the southern district during the last 30 to 40 years indicate also the same general northerly movement as in the northern district, but no indication of any release. Certain points in the Santa Ynez range are apparently now more than 20 ft. north of the position they occupied 30 to 40 years ago. One station, in particular, Gaviota, is shown to have moved about 24 ft. during this period.

Summary—Summing up the situation, the hypothesis of accumulating pressure between blocks of the earth's crust along fault planes until the stresses reach the slipping resistance of the blocks, or the "elastic rebound theory," fits in with (1) the historical record of tectonic earthquakes, (2) the measured movement of established points on the earth's crust, and (3) the evidence of internal stress in the rock masses. Going further, the hypothesis and evidence point to the belief that the stresses were dissipated in 1906 in the northern district to such an extent that a major shock along this portion of the San Andreas fault may reasonably be expected to be deferred for from 20 to 30 years from now. Similarly, in the southern California district the hypothesis of "elastic rebound," the evidence of internal strain, the continued northerly movement of measured points, and the continued occurrence since 1915 of strong local shocks (the last being the Santa Barbara earthquake of June 29, 1925) indicate that the major release of accumulated strain is yet to come.

The point must be clearly emphasized that the historical record of earthquakes in California is brief in extent, is not uniform in accuracy over the period or over all the territory covered, and the causes of internal pressures and their distribution are not definitely known. Therefore no definite prediction of earthquake is warranted.

The records and experience of previous earthquakes, both in California and Japan, prove that structures can be designed that will suffer little if any damage even in the major shocks. When those who live in regions of known seismic activity will frankly admit the certainty of future shocks, and will provide—by proper building ordinances and by proper enforcement of these ordinances—structures frankly designed for resistance to earthquakes, then the earthquake may be met without fear of disaster.

Improvements to Union Station at Ogden, Utah

New Track Layout, Passenger Station and Union Freight Station—Decorative Brick Work on Station Building

IMPROVEMENTS at the Union Station at Ogden, Utah, in connection with the reconstruction of the station building, include revision of the track layout to give increased facilities for handling the traffic. This is a through station, with about thirty trains daily, of which only eight have Ogden as their initial or terminal point. Part of the street front of the headhouse, with the two main entrances, is shown in Fig. 1; a plan of the track and building layout is given in Fig. 2.

Track Layout—Of the nine station tracks, eight are through tracks averaging 2,000 ft. in length, the other being a stub track at the north end to provide for mail service. These tracks, spaced alternately 13 ft. and 28 ft. c. to. c., are served by four concrete island platforms 20 ft. wide and 1,150 ft. long, with a wood platform also beyond the outer track.

The first through track is served by a 40-ft. platform in front of the station building. A part of this platform, 20 ft. wide, is railed off as a concourse, approached from the doorways of the waiting room and having a double stairway to the subway which gives access to the island platforms. This subway, 170 ft. long, is 8 ft. high and 16 ft. wide, provided with gates and railings for ticket inspectors at the entrances to the platform stairways. A steel shed roof covers the concourse and its columns support brackets for a shelter roof over part of the first platform. No shelters are provided on the island platforms, except at the subway entrances.

All station tracks converge upon a four-track approach at the east end and a through track approach at the west end, the track plan comprising 30 turnouts and five diamond slip crossings, all with No. 9 frogs. Track construction consists of 80-lb. and 90-lb. rails spiked to burnetized or zinc-treated ties in gravel ballast.

Station Building—The new headhouse, which replaces one destroyed by fire in 1923 and is built largely on the substantial stone foundations of the latter, is about 372 x 82 ft. in plan. A central lofty one-story portion forms the waiting room, with its accessories, and is flanked by lower two-story portions having station facilities on the first floor. In the waiting room, the ticket office extends along the street side, between the two main entrances, beyond which are the news stand at one end and an emergency hospital or first-aid room at the other end. Two large doorways on the opposite side of the waiting room open onto the concourse, convenient to the subway stairs.

Timber trusses of special design span the waiting room and form a feature of the architectural treatment, as described in *Engineering News-Record* June 4, 1925,

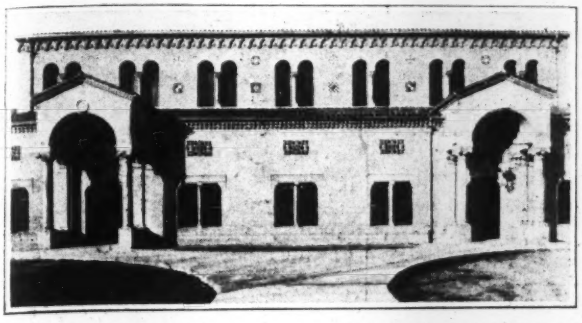


FIG. 1—STREET FRONT OF UNION STATION, OGDEN, UTAH
Note decorative treatment of brick wall.

p. 938. In the two-story portion of the building north of the waiting room are the smoking room, toilet rooms and women's rest room, beyond which is a large baggage room at the extreme end of the building. South of the waiting room are the dining and lunch rooms, kitchen, telegraph office, telephone booths and station offices. These end portions have I-beam girders and transverse wood joists for the upper floor, and the roof is carried by steel trusses. On the second floor are offices for the railways using the station. A ventilating system furnishing washed and re-circulated air is provided for heating the waiting room and can furnish cooled air during the summer. Direct steam radiation is used for the remainder of the building. The heating and ventilating plant is contained in a separate building connected to the station by a tunnel.

Decorated Brick Walls—In the architectural design of the station building an Italian type has been followed. The walls are built and faced with Ogden common brick, laid with a wide flush joint of natural color. This brick varies in color from light buff to red, and the architects state that the resulting color effect is very beautiful, being not unlike the old brick work of Siena. A feature of special interest in the brick facing is its embellishment with marble and tile inserts and cast-concrete or artificial stone trim. These decorations with the belt courses of vertical brick, are shown in Fig. 1.

A continuous lintel of reinforced-concrete encircles the building at the second story and is finished with a brush coat of cement, giving it the same color as the cast-concrete trim. The main entrances on the city side are of Boise sandstone, quarried on the Union Pacific R.R.; red and buff terra cotta tiles made near San Francisco are used for the roof. Tiling is used for the floor and wainscot, while the upper part of the interior walls is finished in plaster. The building is separated from the street by a lawn 140 ft. wide and access to the passenger facilities is provided by a system of walks and driveways leading from 25th St.

Other Facilities—South of the main building is an annex for express service and beyond this is the commissary building for the dining-car service. North of the building is the supply house for train and yard men, and then the mail building, the latter being served by a spur track. Further north is the union freight station with ten stub tracks. Eight of these are house tracks, served by the freighthouse platform and two island platforms, while the other two are team tracks on either side of a concrete driveway. Stone block paving is used for the freighthouse driveway. Adjacent to this freight station is an automobile platform, serving two tracks and accessible from ground level by a broad incline.

Engineers and Contractors—This union station, owned jointly by the Union Pacific Ry. and the Central Pacific Ry. (Southern Pacific System), and used also by the Denver & Rio Grande Western R.R., is under the management of the Ogden Union Railway & Depot Co. Under R. L. Huntley, chief engineer of the Union Pacific Railway System, the improvement work was in general charge of W. R. Armstrong, assistant chief engineer, and D. S. Meadows, engineer of bridges and buildings, Oregon Short Line (Union Pacific System); with H. W. Sheley, assistant engineer, in resident charge. For the new building, the architects were John Parkinson and Donald B. Parkinson, Los Angeles, Calif.; the H. W. Baum Co., Salt Lake City, was the contractor. The cost of the building was approximately $300,000.

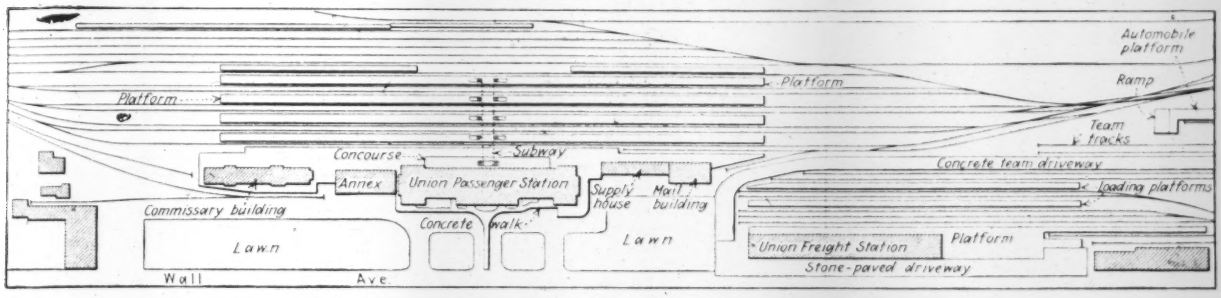


FIG. 2—GENERAL PLAN, OGDEN UNION STATION

American Traffic in the Panama Canal

Traffic of American shipping through the Panama Canal in 1925 represented 54.6 per cent of the total cargo traffic of 23,958,836 tons, but this American traffic is confined mainly to three or four trades, according to the *Panama Canal Record*. More than 75 per cent of the total shipping under the American flag was in the North American intercoastal trade, and this trade, with three others, comprised 96 per cent of all the transits and accounted for 98 per cent of all the cargo through the canal under the United States flag during the year. In traffic between Europe and the west coast of South America, and between Europe and Australasia, the cargo tonnage in American bottoms was practically nil. In traffic between the east coast of North America and Australasia, and between Europe and the west coast of North America, the tonnage carried by American vessels comprised but a relatively small part of the total through the canal. In no trade did American vessels secure any considerable proportion of cargo tonnage except in those which had the United States either as origin or destination. Tank ships under the American flag represented 80 per cent of the total tank-ship tonnage, and comprised 36 per cent of the transits and 41 per cent of the tonnage under this flag.

Cranes Increase Pier Capacity Over 300 Per Cent

Full-Arch Cranes of 10- and 20-Ton Capacity Built for N. Y. Central Railroad to Handle Boxed Automobiles for Export

THE INSTALLATION of two traveling and revolving cranes of the full-arch type in ratings of 10 and 20 tons respectively has increased the capacity of West Shore Pier 6 in the Hudson River at Weehawken, N. Y., between 300 and 400 per cent. This pier is used almost exclusively for handling boxed automobiles and trucks for export. Previous to the installation of the cranes steam derrick lighters and locomotive cranes were used on the pier and the loading of 25 or 30 boxed automobiles was considered a good day's work; the new cranes have handled from 100 to 130 cars per day, which is equivalent to about 700 tons.

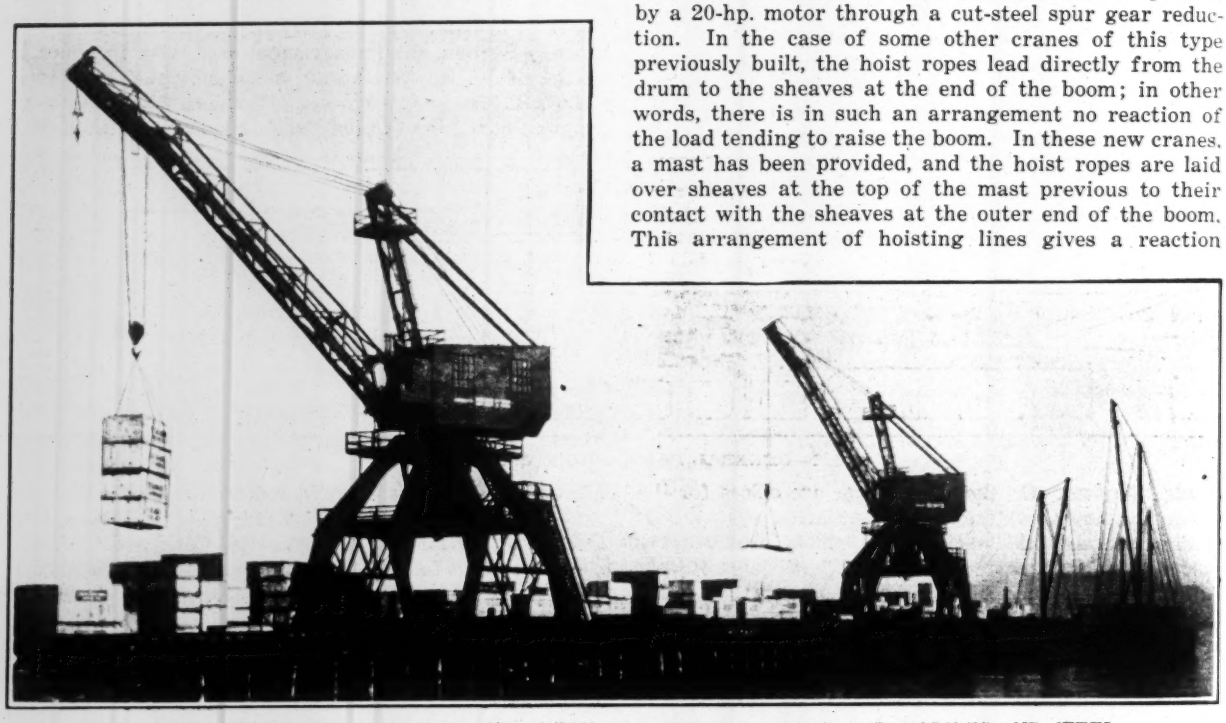


FIG. 1—TRAVELING CRANES OF 20 AND 10-TON CAPACITIES LOADING AUTOMOBILES AND STEEL PLATES ON HUDSON RIVER PIER

Considerable reconstruction of the pier was necessary in order to receive the crane runway and also to provide increased storage space so that the capacities of the cranes could be used efficiently; in effect reconstruction included widening the pier from 75 to 95 ft. and the installation of railroad tracks. The finished pier contains four tracks, two located under the crane portals on 13 ft. 3 in. centers, and two others symmetrically placed on the opposite side of the pier. This arrangement provides a 30-ft. storage space along the center of the pier. The length of the pier overall, measured from the bulkhead line, is 869 ft.

Both cranes utilize a screw luffing arrangement for raising the boom. The 20-ton crane has an overall length of 53 ft. and a span of 34½ ft.; roadway clearance is 22 ft. It is provided with two 2-wheel trucks spaced 12 ft. c. to c. at each of the four corners, while the wheelbase c. to c. of corner trucks is 34½ ft.; this arrangement provides for a maximum wheel load of approximately 37,000 lb. Both wheels in the inner truck at each corner are driven through cut-steel spur and beveled gears by a 60-hp. motor. The portal is plate girder construction and the rotating structure is of the so-called pillar type, the pillar being built up of structural steel members. While the pillar has a bearing at its base, this bearing is designed to take lateral loads only, the vertical load being carried by a heavy cast-steel ring at the top of the pillar. The outer side of this ring also forms the large gear with which the pinion effecting the crane rotation meshes. The main girders forming the floor of the machinery house are integral with the pillar construction. The boom is hinged at the forward end of the machinery house and the luffing action for raising it is obtained by means of a special screw and nut mechanism, which is operated by a 20-hp. motor through a cut-steel spur gear reduction. In the case of some other cranes of this type previously built, the hoist ropes lead directly from the drum to the sheaves at the end of the boom; in other words, there is in such an arrangement no reaction of the load tending to raise the boom. In these new cranes, a mast has been provided, and the hoist ropes are laid over sheaves at the top of the mast previous to their contact with the sheaves at the outer end of the boom. This arrangement of hoisting lines gives a reaction tending to raise the boom and thus reduce the load on the screw luffing mechanism. The main hook block, which is reeved in four parts, is so located that a 60-ft. maximum radius is obtainable; the auxiliary 5-ton hook block is placed at a 70-ft. maximum radius. The minimum radii of these hook blocks are 25 and 35 ft. respectively, and are obtained with the boom in its highest position.

In general structure arrangement, the 10-ton crane is practically a duplicate of the 20-ton crane but only one 2-wheel truck is provided at each corner and one wheel in each truck is driven, this arrangement thus providing for driving half of all the wheels the same as in the 20-ton crane. The maximum wheel load of this crane is approximately 48,000 lb. The 10-ton hook block is located on the boom so as to obtain a 70-ft. maximum radius and a 35-ft. minimum radius. Overall dimensions of the crane are: span 34½ ft.; wheelbase c. to c. of trucks 34½ ft.; c. to c. wheels in each truck 4½ ft.; and total length 45 ft. 9 in.

Machinery and Operating Characteristics—The electrical equipment was designed to operate on 3-phase, 60-cycle, 230-volt current and is collected from two under-running contact rails located one on each side of one of the crane runway rails, the latter being used for the third element of the circuit.

The same system of motors is used on both cranes as follows: Crane traveling motor, 60 hp.; rotating motor, 20 hp.; boom hoist motor, 30 hp.; main hoist motor,

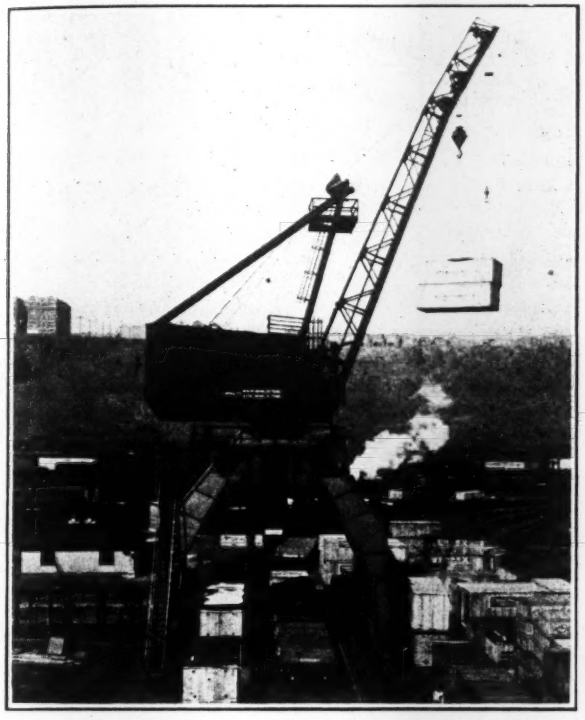


FIG. 2—20-TON CRANE LIFTING AUTOMOBILES WITH MAIN HOOK BLOCK
Note 5-ton auxiliary hook block at outer end of boom.

60 hp.; auxiliary hoist motor, 80 hp. All motors are equipped with automatic solenoid load brakes, and the hoist engines have an auxiliary mechanically operated hand brake.

Magnetic control is provided for all motors, except those for the rotating movements, and suitable interlocking devices are arranged where required. The hoist and slew controllers are combined in such a way that one operating lever actuates both motions. For example, the arrangement is such that depressing the controller handle lowers the hook block and rotating the controller handle to the right causes the crane to rotate in this direction; moving the controller in opposite directions of course causes reverse effects from these cited. Two sets of combined controller units are provided for the 20-ton crane. The first set operates the rotating motor in combination with the main 20-ton hoist motor; the second set operates the rotating motor in combination with the 5-ton auxiliary hoist motor. A suitable switch is provided so that it is impossible to obtain current on more than one set of combined controllers at the same time. Limit switches of approved design are installed on the main hoist, the auxiliary hoist and the screw luffing boom mechanisms. The speeds of the several movements are as follows: Traveling speed along the pier, 150 f.p.m.; rotating speed, 1.2 r.p.m.; boom hoisting speed, 20 f.p.m.; 5-ton hook block, 20-ton crane, 160 f.p.m.; 20-ton hook block, 20-ton crane, 40 f.p.m.; 10-ton hook block, 10-ton crane, 80 f.p.m.; magnet hoisting speed, 10-ton crane, 80 f.p.m.

The 10-ton crane is equipped with a 62-in. magnet for handling metallic freight, and, inasmuch as the operating current supply is alternating, a 15 kilowatt direct-connected a.c.-d.c. motor generator set is installed in the machinery house on this crane, which furnishes the 230-volt d.c. current necessary for operating the magnet. Both cranes are equipped with hand-operated rail clamps which are interlocked electrically, making it impossible to move the crane by power while the clamps are in place.

Personnel—For the railroad, the cranes were installed under the general supervision of George W. Kittredge, chief engineer; the mechanical details were handled by J. J. Van Buskirk, mechanical engineer; and C. L. Spaulding, district engineer, was in charge of the work in the field. The cranes were designed, fabricated and erected by Heyl & Patterson, Inc., Pittsburgh, Pa.; this company's part of the work at the site was under the immediate supervision of E. Logan Hill, eastern manager.

How Laboratory Supervision Saved Omaha $9,000 Per Year

By Kenneth C. Armstrong
Assistant Chemist, Metropolitan Utilities District, Omaha, Neb.

Abstract of paper presented at the Dubuque meeting of the Iowa Section, American Water Works Association.

FORMERLY chemical dosage of the filter influent at Omaha was raised and lowered according to the judgment of the chemist, based largely on color of the raw water and turbidity of the basins. With pumpage varying from 18 to 45 m.g.d., the amounts of colloidal and dissolved material constantly changed, making the turbidity fluctuation in the effluent of the basins large. In adding coagulants to the settled water the chemist was likely to use unnecessarily large amounts. Determination of the dosage is now made with a laboratory mixing machine which holds eight 2-qt. fruit jars to each of which have been added varying combinations of lime, alum and iron sulphate. The machine is turned by a motor for ½ min., then the jars are left standing for 50 min. The combination giving the least turbidity is then used.

Quite by accident while experimenting with iron sulphate for the removal of color, it was found that a small dosage of the iron compound (¼ gr. per gallon) enabled the alum to be reduced from 2¼ gr. to 1 gr. per gallon. If more iron sulphate is used more lime is required, consequently it has been found more economical to increase the alum when an increase is necessary. According to laboratory tests, the ferrous sulphate should be used first, but in practice it was found satisfactory to mix the alum and ferrous sulphate in the solution tanks. The mixture should not stand long, otherwise the iron oxidizes and precipitates. Lime is added ahead of the application of the mixture.

A rough approximation of the size of the suspended matter was determined by settling the raw water in a 4-ft. vertical iron cylinder made by welding a plate on the bottom of a piece of 2-in. pipe. After settling 1, 2, 3 and 6 hours, raw water placed in the pipe was drawn off. The 3-hour period gave the best indication and the turbidity readings could be interpreted into coagulant dosages required.

Compared with the average for the six previous years the cost of chemicals in 1925 has shown a decrease of from $500 to $1,500 per month. The saving will probably reach $9,000 for the year, treating water with a turbidity considerably higher than that of 1924.

Repairs to a Quay-Wall at Key West, Fla.

Oxidation of Reinforcing Steel Causes Concrete to Spall—Cement Gun Repairs on Wire Mesh Follows Sandblasting of Exposed Steel

By E. C. Siebert
Lieutenant, Civil Engineer Corps, U. S. N.

REPAIRS with the cement gun are being completed on a reinforced-concrete quay wall at the United States Naval Station at Key West, Fla. A typical section of the quay wall which was completed in November, 1912, after a construction period of approximately 20 months and costing $136,000, is shown in Fig. 1. Several years prior to 1923 the structural condition of this quay wall due to deleterious action of the sea water was sufficiently bad to indicate the necessity of extensive remedial measures, finally begun in April, 1924.

Description of the Structure—The total area of deck surface is approximately 56,000 sq.ft. As may be seen from Fig. 1, the waterfront sections of the quay are reinforced slabs 40 ft. wide supported on reinforced-concrete piles and girders, and joined by a sloping reinforced-concrete apron and girders to a row of fully embedded anchor piles along the inboard edge of the structure. There is a fill to the deck level behind the entire inner line of the wall. A line of creosoted wood sheetpiling holds this fill.

A system of reinforcing is used consisting of alternate and parallel straight and bent rods in the slabs. The straight rods are located near the bottom of the slab and tied to the concrete by flat stirrups; they are turned up for a short distance at the ends. The bent bars start near the top of the slab and bend downward, so that in the middle of the span they are in the same horizontal plane as the straight bars. The bent bars are without stirrups. The same general arrangement of steel obtains in the beams.

A detail of the precast reinforced-concrete piles that were used is also shown in Fig. 1. There is a total of 1,105 such piles in the structure, spaced 10 ft. in each direction. As will be noted, the piles have cast-iron points and their lengths vary from 28 to 45 ft. The submerged portions range from 1 ft. to 20 ft. at mean low water, the ordinary tidal range being about 18 in. The height of piles above high water is 6½ ft.

A 1:2:3 mix of concrete was used in the piles. For girders and slabs a 1:2:4 mix was used. The thickness of concrete cover over the pile reinforcing varied from 1½ to 2½ in. The longitudinal reinforcement in the beams was about 1 in. from the surface in general. The stirrups, however, were often within ¼ in. of the surface. The beams are 14 in. deep and the top of the deck is 24 in. above the bottom of the beam. This deck slab is 10 in. thick, increasing to 11¼ in. at the front and the rear, making the slope of the deck toward the center for drainage.

Conditions to Which Structure Has Been Subjected—The structure faces west and was, until the completion in 1922 of a breakwater, exposed to the severe wave action of storms. The water contains but little sewage and no chemical waste except slight quantities of oil which has lightly coated the piles between high and low water. Below low water the piles are covered with a thin growth of moss. The average yearly air temperature at Key West is approximately 78 deg. F. and that of the water 76 deg. F. Variations in temperature are small and there is never freezing weather. The

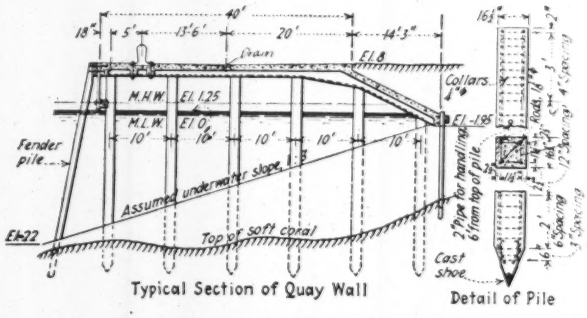


FIG. 1—DETAILS OF QUAY-WALL STRUCTURE AT KEY WEST, FLA.

form of the quay wall is such as to pocket damp air under it.

Condition of the Structure Before Repair—Under the above conditions, cracking of the concrete due to corrosion of the reinforcement developed within one year after the completion of the structure, this cracking being progressive. Although this cracking and spalling were present in many places due to the pressure exerted by corrosion of embedded reinforcement, no softening due to chemical action of the sea water was observed. Over 50 per cent of the piles were cracked vertically directly over the reinforcement, in many cases exposing the steel. The cracks seemed to be open most at a point about 2½ ft. below the top or El. 3.5 ft. above mean low water. The examination of one cracked pile showed the reinforcing to be embedded 3 in. from the surface.

A great many of the beams were also cracked under

MATERIALS

Cement, bags	3,397
24 bags of this was alumina cement	
Sand, cu.yd.	368
Mesh, sq.ft.	17,552
Average cement per sq.ft. of area repaired	0.08442 bag
One bag to 11.87 sq.ft.	
Average total sand per sq.ft. repaired	0.00915 cu.yd
One cu.yd. to 109.29 sq.ft.	
Area repaired	40,236 sq. ft.
Area mesh used	2.29

MATERIAL COSTS

Material	Totals	Percentage of Total Material	Percentage of Total Cost of Work
Cement	$2,346.63	43.6	20.7
Sand	1,036.03	19.2	9.2
Reinforcement	557.51	10.3	4.9
Air	930.17	17.3	8.2
Water	31.33	0.6	0.3
Tie wire, expansion bolts, etc	4.39	0.1	0.04
Renewal and repair material	481.77	8.9	4.3
Totals	$5,387.83	100.0	47.64

LABOR COSTS
(Exclusive of Superintendence)

Labor Items	Totals	Percentage of Total Labor	Percentage of Total Cost of Work
Moving staging and equipment	$472.57	8.0	4.2
Cleaning away spalled concrete	1,995.77	33.6	17.6
Changes and additions to air piping, etc.	76.72	1.3	0.6
Sandblasting	406.97	6.8	3.6
Placing reinforcement	639.24	10.8	5.6
Guniting	1,580.98	26.6	14.0
Cleaning cement gun, etc.	174.54	2.9	1.5
Handling cement	133.64	2.2	1.2
Handling sand	413.36	7.0	3.7
Pumping and miscellaneous labor	49.84	0.8	0.4
Totals	$5,943.63	100.0	52.4
Superintendence charged	.....	.....	.....

Average cost per square foot of area repaired, is $0.282 (exclusive of equipment cost and superintendence).

the reinforcement. Not infrequently the entire layer of concrete below the steel had spalled off and the steel was very seriously oxidized. The beams of the inclined apron are the most seriously affected. There are many rust stains on the under surface of the slab, in some cases being present where no cracking has as yet occurred.

In the locality of Key West, steel corrodes with great rapidity wherever exposed in any way to the action of the atmosphere. Furthermore, the design of this structure was such that moist air was trapped under the deck slab accelerating this action along the shore side. Some of the rods were reduced in area fully 50 per cent; others were entirely gone. Many of the stirrups in the beams had completely corroded away.

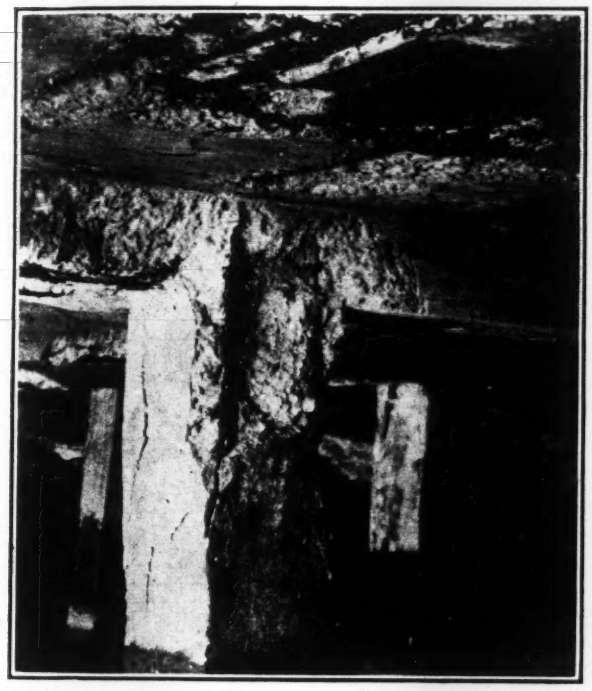


FIG. 2—SPALLING ON PILES AND BEAMS AND METHOD OF REPAIR

Remedial Measures—The first plan considered for repair was to post up each damaged pile from the water level, using concrete placed in a small clamped-on cofferdam form. The deck in this method was to have been replaced in substantially the same fashion as it was originally installed.

This scheme, however, was abandoned in favor of sandblasting the steel and then covering it by means of the cement gun. The quay wall was designed for a loading of 500 lb. per sq.ft. and its actual total loading had always been comparatively light. For this reason and because of the excessive cost which would be involved in putting the structure back to design strength, it was decided to make practically no steel replacements. Wire mesh was wrapped about the cleaned and sandblasted columns and beams and at such other places as seemed advisable before applying the cement.

A 50-ft. barge of about 2-ft. draft was fitted out with a cement gun, steel mixing platform, sand and cement bins, bin for the sifted sand recovered from the blast, tool storage and necessary fresh water tank and pump. The cost of fitting out the barge, excluding the cost of the hull of the barge, was approximately $3,000. Compressed air was available along the length of the quay wall at 60 lb. pressure.

In prosecuting the work the ordinary procedure consists of first hanging a timber working platform under the quay wall by cables passing through the top surface of the structure, then knocking off by hand the spalled concrete and rust flakes from the reinforcement. Limited working space excluded the use of air hammers. The steel was next sandblasted, after which 2-in. galvanized steel mesh was secured around the piles, beams, and at such other points as necessary. Expansion bolts have been used for securing the mesh and have proved an economy over other means.

It takes two coats of mortar from the cement gun to get a thickness of 2 in. on the under sides of slabs and beams, although if shot from the water line upwards a 4-in. thickness on the columns may be put on in one operation. However, two-coat work has been the rule for the whole structure, the second being applied the day after the first. The average total thickness of cover on finished columns is about 6 in., while that on other surfaces averaged about 2 in.

The labor required on the barge consists of one man to operate the cement gun, one man to load it, and two men to mix cement and sand. The cement and sand for the 1:3 mix for the machine are mixed as follows: An open-bottom, 12-cu.ft. box, 1 ft. deep, has alternate layers of sand and cement placed in it, the sand layers being about three times the thickness of those of the cement. The box is lifted and the mixture shoveled through a ¼-in. mesh screen, after which it is shoveled into the cement gun. Under operating conditions about one-third of the sand in the mortar thrown from the nozzle rebounds, but under favorable conditions was mostly recovered. The recovered sand contained so little cement that it seldom caked and was used in the sandblast. From the above, it may be seen that the mortar actually placed is of something like a 1:2 mix, due to the escape of part of the sand.

Six barrels of high alumina cement were placed on about 292 sq.ft. of surface, the average thickness being about 2 in. There was no discernible difference in the actual working of the portland cement mortar and the high alumina cement product. No advantage in application was noted. However, the relative durability of these two cements under the given conditions will be ascertained in the future.

Examination of surfaces of the quay wall repaired 14 months ago reveals a soundness of the work, with no indications of failure. The work is now practically complete and the total money that will have been spent to accomplish the repair will be moderate—roughly, one-ninth of its original cost and one-nineteenth of the estimated cost of a similar new structure if built at the present time.

Cost Data—Quantity and cost figures are given in the table below. These figures do not include any part of the original cost of equipment nor superintendence charges. As stated above, also, the cost of equipping the cement-gun barge was about $3,000. The work was done under occasional but not extraordinarily adverse conditions incident to ship and boat landings in bad weather. The accompanying figures are all based on the cost of repair of 40,236 sq.ft. of surface.

Highway Bridge Construction Activity in 1925 (*Concluded*)

Bridge Replacement and Construction Going on at Exceptional Rate in all Sections—Many New Crossings of Large Streams Being Built and Projected—Activity Promises to Continue

The first part of this review of highway bridge construction activity during 1925 and construction under way or projected for 1926 was published in "Engineering News-Record," January 14, 1925, p. 79, and described highway bridges in the Atlantic Coast and the Southern States. The review is concluded here with description of highway bridges in the Central and Western States.

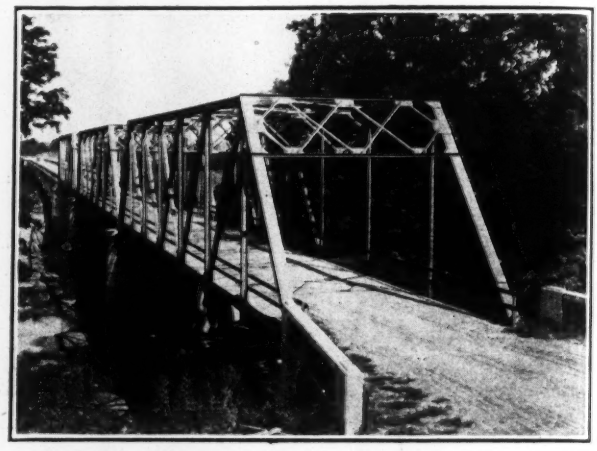
Central States

OHIO'S work, chiefly replacement, includes a 150-ft. concrete through arch near Conneaut, the largest of the type yet built in the state and a 325-ft. steel span over the Sandusky at Old Fort (20-ft. roadway). Of a total of 164 new bridges completed or placed under contract this year, 45 are concrete deck beam structures, 67 concrete through girders, 14 concrete rib arches, 5 concrete spandrel filled arches, 18 steel truss bridges, 4 plate girder bridges, and 1 concrete deck cantilever. Roadway widths were most largely 24 ft., but many of 20 ft. were built and one of 18. At least four structures of half a million or more in cost are projected for the coming year. Ohio is also profiting by the construction of the two Ohio River bridges at Bellaire and Huntington; there is a project for a third Ohio River bridge at Portsmouth, which will be the only highway bridge between Cincinnati and Ironton.

While Indiana has no large streams, it was in the front rank in highway bridge expenditure in 1924, and again in 1925 with about $2,000,000. Its most important operations concerned the relief of inadequate traffic conditions into the southwestern corner of the state, hitherto largely isolated, and on important state and federal through routes. They include two large steel truss bridges, totaling eight spans of about 200 ft. each, over the White River near Bedford and Washington, respectively, the latter replacing a century-old ferry, the last on the state highway system, and opening up a new route between Evansville and Indianapolis; reinforced-concrete bridges with arch spans of 100 to 150 ft. over Sugar Creek near Rockville, and over Silver Creek near New Albany, both on national through routes, and a similar through-route concrete arch structure over Deer Creek on the historic National Road. A projected interstate bridge between Vincennes, Ind., and Lawrenceville, Ill., 1,600 ft. long, will be particularly important because there are no bridges over the Wabash south of this point, and none north closer than Terre Haute. Projects for two Ohio River bridges, at Jeffersonville and Evansville, promoted by private parties, have not yet advanced to a stage of definite financing.

Only a moderate amount of important bridge work was done in Illinois. Of four large bridges and one important grade separation built, the most important was a $222,000 crossing of the Kaskaskia at Evansville, comprising some 700 ft. of steel truss spans and nineteen 50-ft. concrete girder spans, one of the steel truss spans being designed for conversion to a vertical lift when required.

Michigan, with its dense railway network, did extensive grade separation work. Three cantilever concrete bridges simulating arches were built, over the Raisin River at Monroe (42-ft. roadway), and at Rockwood and Bay City respectively (40-ft. roadways). A small plate-girder bridge west of Grand Rapids replaces one of the last remaining ferries in the state, a chain ferry, and opens up a new short-cut highway westward. The coming year's program includes about a dozen structures of considerable magnitude, including an interstate bridge (Wisconsin) over the Menominee near Iron Mountain. All will have wide roadways, under the present policy of the State Road Department. Important traffic will be served by the projected Detroit-Windsor bridge, a private toll structure involving a large suspension span. Wisconsin has had only work of normal size during the past year, but is projecting a $300,000 bridge at Shorewood (three 123-ft. arch spans on sharp skew, 60-ft. roadway width). During each of the past five years the state has built 400 or more bridges annually, of average cost $4,500 and length 30 ft. Minnesota will have several bridges of important size during 1926. The cities of St. Paul and Minneapolis and Hennepin County are engaged in three large bridge operations (Robert St. bridge, St. Paul; Intercity bridge; Minnesota River bridge at Fort Snelling).



A SUBSTANTIAL STEEL HIGHWAY BRIDGE—LITTLE WABASH RIVER, ILLINOIS

Iowa's work during 1925 was exclusively of structures of ordinary type and magnitude. For future construction, a large bridge across the Mississippi to connect Iowa and Wisconsin has been under study by the highway officials of the two states, under legislative direction, but the project is only in its early stages.

Of its great $2,000,000 construction program of five Missouri River bridges, South Dakota completed two during the past year and one the previous year, leaving two to be completed. That at Mobridge, 1,418 ft. long, five spans on concrete piers, was completed late in 1924. The bridge at Wheeler, 1,676 ft. long of six spans, and that at Chamberlain, 1,479 ft. long of four

spans, were completed on Sept. 1 and Sept. 22, 1925, respectively. The bridges at Pierre and Forest City, to be completed next summer, will be 2,072 and 1,769 ft. long respectively. They have 22-ft. concrete floors with ¾-in. Tarvia coating. North Dakota completed a bridge across the Red River, between Pembina and Vincent, Minn., and is preparing for the construction of four large bridges, two across the Missouri (at Spanish and Williston), one over the Red River at Fargo (to Moorhead, Minn.), and one over the Upper Des Lacs east of Bowbells.

Missouri completed its program of building four great crossings over the Missouri River, which previously had only two road crossings in the entire width of the state. The Lexington bridge, last of the series (Boonville, Glasgow, Waverly, and Lexington), was opened to traffic Nov. 5. These four bridges, with the five built by South Dakota and the Meridian highway bridge, constitute one of the most remarkable phases of highway bridge construction in the last two or three years, as they more than double the number of points at which the Missouri River is crossed by highways. Minor river bridges completed in Missouri were mainly combinations of steel-truss channel and woodpile trestle approaches. Its total of contracts let during the year reached two and a half million dollars.

MISSOURI RIVER BRIDGE AT WAVERLY, MO.—A NEW CROSSING

Arkansas completed some 40 or 50 bridges over streams not heretofore bridged. Of three major bridges now under construction, one replaces an old ferry and the other replaces a bridge which was impassable six months of the year, being in the flood area of the Mississippi. Three bridges projected for the coming year, 1,000 to 2,500 ft. long, over the White River, St. Francis River, and Arkansas River, will replace two ferries and an old pontoon bridge (see view of Dardanella pontoon bridge). An approach to the Harahan bridge, the lowest bridge on the Mississippi River, is also to be started during the coming year, involving a cost of about $1,000,000.

Toll ferry elimination on a remarkably large scale is under way in Louisiana. Completed or nearly completed projects of this kind cross D'Arbonne bayou near Farmersville, Bayou Macon at Delhi, Mermenlau River near Jennings, Sabine River at Orange (5,000 ft. of bridging and 10,000 ft. embankment) and Lake Lafourche near Rayville. Equally active work of the same type is about to begin, including crossings of Little River near White Sulphur Springs and near Archie, Tensas River at Clayton, Black River near Jonesville, and Ouachita River near Harrisonburg and at Monroe. Quite as important in this state of wide waterways and inlets are the enterprises which open entirely new traffic routes. An 8,800-ft. crossing over Pass Manchac, northwest of New Orleans, will save 100 miles of road distance on the 40 or 50 miles between that city and Hammond, while bridges over East and West Pearl River near the town of Pearl open up a new route eastward to the Gulf Coast of Mississippi. Surveys are in progress for crossings over the important navigable passes of the Rigolets and Chef Menteur, outlets of Lake Pontchartrain to the Gulf.

Louisiana also has a private bridge project of unusual character, for a causeway across a neck of Lake Pontchartrain near its mouth involves six miles of bridging and twenty miles of approaches. The State Highway Commission recently awarded a franchise for this crossing to a private corporation, a proceeding that led to much public discussion pro and con.

Western States

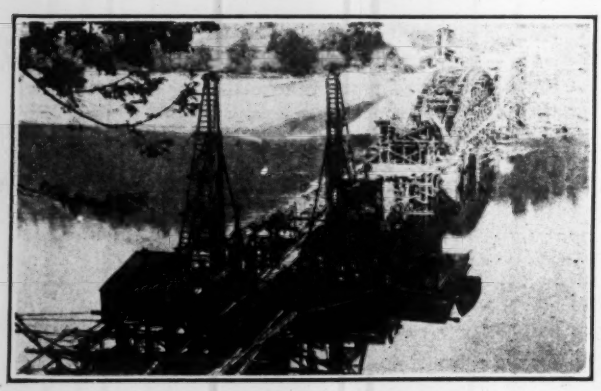
Four bridges of more than ordinary magnitude were completed by Wyoming, including a 380-ft. steel bridge over the Shoshone west of Lovell and a 160-ft. concrete bridge over the Shoshone on the Cody-Yellowstone Park road. A 330-ft. steel bridge over the Snake River at Menor's Ferry is definitely projected and it is possible also that important bridges will be built over the Powder, North Platte, and Wind Rivers. Treated-timber bridge construction constituted much of the bridge work during the past two years. In Idaho, two combined bridges and grade-crossing elimi'nations of concrete were built and a concrete bridge over the Salmon River, at Salmon is now under construction. Plans have been made for a bridge to replace a ferry over the Pend d'Oreille River near Newport, Wash. (five 248-ft. spans). A private toll bridge is in prospect at Twin Falls, crossing the wide Snake River canyon.

Colorado built half a dozen large bridges of spans up to 150 ft., and a wood pile trestle with reinforced-concrete floor over the South Platte near Merino, many replacing old structures with 12 to 16-ft. roadways, the new crossings being designed mainly with 20 to 24-ft. roadways.

Detailed data from Pacific Coast and southwestern states are lacking, but activity in Washington, Oregon and California has been fully equal to that elsewhere. Operations in Arizona and New Mexico have been on a smaller scale. Texas has been occupied with large interstate bridge projects on its eastern and northern boun-

daries, but progress on these has been delayed by legal questions relating to the propriety of expending state money on work of this particular kind.

State bridge work totaling about $2,300,000 is under construction in Washington. Four bridges on the Pacific Highway relocation between Everett and Marysville make up nearly half this total; roadways are 24 ft. wide, spans are steel (including one vertical-lift and two swing draws) and viaduct sections of concrete, and all floors are concrete. The Puyallup River bridge north of Tacoma, $730,000, has a 36-ft. roadway and two 6-ft. sidewalks, on 1,100 ft. of steel truss spans and 1,750 ft. of concrete viaduct. Concrete arch bridges were built over the Elwha River near Port Angeles and over the Chehalis River near Chehalis. Contract is about to be let for a 520-ft. cantilever bridge over the Columbia River at Vantage Ferry, near Ellensburg,



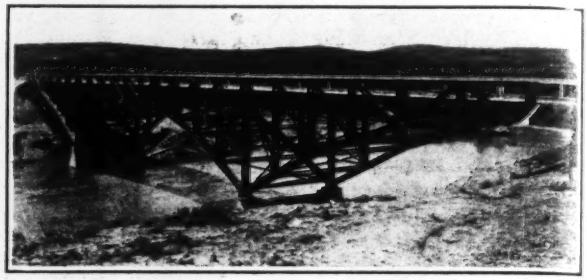
KLAMATH RIVER BRIDGE, REDWOOD HIGHWAY, CALIFORNIA

to eliminate a county ferry. Two bridges of almost equal magnitude form part of the coming year's program, to cross the Columbia at Kettle Falls (500-ft. span) and the Queets River (two 300-ft. spans).

California built a large number of concrete bridges and some interesting composite concrete and timber structures. Current work and work for 1926 are of even greater volume, the summary being as follows: 20 bridges completed by the state and 4 by counties under state supervision; 19 now under construction, 47 definitely projected for 1926. The completed work includes seven trestles of 30-ft. spans across Pit River, having reinforced-concrete bents with timber decks surfaced with asphalt, a type "very practical for remote locations." VanDuzen River bridge, Humboldt County, has three 163-ft. open-spandrel concrete arches; and Truckee River bridge, Nevada County, one 160-ft. span of the same type; a similar bridge, also over the Truckee River, is under construction, as is also one over Charley Creek, in Shasta County (see view). Some similar structures are included in the projected work. California uses concrete girder spans up to 60 ft. A number of bridges are being built with sidewalks, and some sidewalks are being added to existing bridges.

City and County Bridge Construction

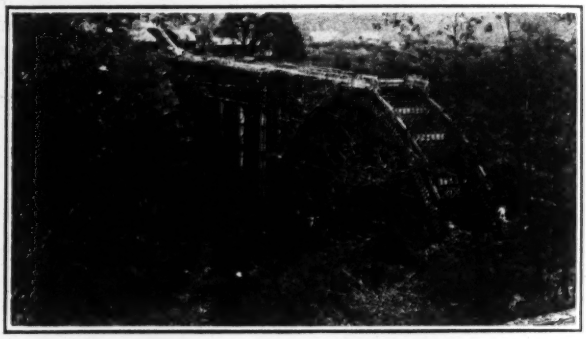
Many of the most notable operations of 1925 were carried on by cities and counties. Only hasty reference to these is possible here. In Portland, Ore., Multnomah County has been occupied with its great bridge program involving four crossings over the Willamette River, of which the Sellwood bridge, just completed, was opened



GREEN RIVER BRIDGE, LINCOLN HIGHWAY, WYOMING

to traffic in December. The city has just begun construction on a 250-ft. concrete arch over Jefferson St. Canyon, a structure to be built of 1:1:2 concrete and having other interesting features. Los Angeles completed six large bridges, the most important of which is the 9th St. viaduct across the Los Angeles River, 1,775 ft. long, and has under construction five more, of which Macy St. viaduct across the Los Angeles River and Anaheim St. viaduct across Dominguez Slough reach half a million dollars each. The Macy St. viaduct has a 215-ft. open-spandrel arch span across the river. Ten other concrete bridges of even larger size are definitely projected.

In the East, the outstanding municipal work, other than that at St. Paul and Minneapolis, already noted, is



CHARLEY CREEK BRIDGE IN SHASTA COUNTY, CALIFORNIA, 148-FT. SPAN

at Cleveland and Pittsburgh, in both of which cases the county is the constructing agency. Cleveland will probably begin this year the $15,000,000 Carnegie Ave. crossing over the Cuyahoga Valley. Allegheny County is building in Pittsburgh the three new self-anchored suspension bridges over the Allegheny River, three bridges over the Monongahela, and several minor structures.

Prospects for 1926

Figures given in the course of the preceding review indicate that state and city work in 1926 will equal and probably exceed by 10 to 15 per cent the 1925 volume. Large projects of private, public, and semi-public authorities will add considerably to the total. These include, in the construction stage, such work as the Carquinez Straits bridge in California, the Memorial Bridge over the Potomac River at Washington, the South Shore bridge at Montreal, and the Mid-Hudson bridge over the Hudson River at Poughkeepsie; in the stage of authorization such undertakings as the Arthur Kill bridges in New York Harbor; and in the project stage, such enterprises as the Detroit-Windsor bridge over the Detroit River, Twin Falls and San Francisco Bay bridges, and New Orleans and Mobile Bay crossings.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

More Fuel to the Flames

NIAGARA IN POLITICS: A Critical Account of the Ontario Hydro-Electric Commission—By James Mavor, Emeritus Professor of Political Economy in the University of Toronto; Author of "An Economic History of Russia," etc. New York: E. P. Dutton & Co. Cloth; 5 x 8 in.; pp. 255. $2.

Professor Mavor, for many years professor of political economy in the University of Toronto, was one of the most distinguished economists of Canada. This critical account of the Ontario Hydro-Electric Commission was his last work. He died late last year.

The economics of the Hydro-Electric Power Commission of Ontario has been the subject of many disputes and a few so-called investigations, but it long since became evident that nothing short of a judicial inquiry, accompanied by all the power of subpoena and punishment, would supply the information necessary to pursue the elusive fact through the tortuous channels of accounting that "Hydro" has set up. Several of such investigations have been held, but the results are not known to the world. If there were results, they are buried in the archives which are guarded so carefully by the same sinister political influence that Professor Mavor denounces in his book. Engineers have studied Hydro and have issued reports upon it, but none of these reports has withstood either the acid test of fact or the charge of bias. Hydro remains, therefore, a mystery, accounted on the one hand, by its adherents, as the savior of the people and on the other, by its opponents, as a destructive and expensive agency of socialism.

Professor Mavor's book adds little to the detail appraisal of Hydro's financial soundness, but it is extremely instructive on the political significance of this enormous governmental activity.

The contention is simple. It is that the Hydro-Electric Power Commission of Ontario has become in essence the Government of Ontario. Started merely as a minor governmental agency to control the development of a part of the Niagara power, it has grown into an enormous political machine which dictates the policy of millions of people. Everything in Ontario, according to the author, hinges on its relation to the Hydro policy. Governments stand or fall on this policy. Officials are made or broken as they conform to the policy. Everything else in the province fades into insignificance compared to the sinister control of the destinies of the province by those who are concerned in putting through the interwoven plans which govern this one important, but by no means all commanding, activity, the production and distribution of electrical energy.

The author makes his point. The sword thrust has gone home, as the many protest editorials by the Hydro controlled newspapers of Ontario now testify.

The example of Ontario should be held up to all of the people of Canada and the United Stated who are now driving toward similar public ownership. Whether or not Hydro is essentially economical is secondary to the present argument. The point Professor Mavor raises is: Is it desirable to establish a governmental agency of such tremendous potentiality and intricacy that it will come to control the whole governing activities of a community and curb the freedom of the people's control of other activities?

Light, Radiation and Health

LIGHT AND HEALTH: A Discussion of Light and Other Radiations in Relation to Life and to Health—By M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of General Electric Co.; and A. J. Pacini, Director, Department of Biophysical Research, Victor X-Ray Corporation of General Electric Co. Baltimore: The Williams & Wilkins Co. Cloth; 6 x 9 in.; pp. 302; 31 halftones and line cuts. $5.

Collaboration of these two special research workers in lighting and radiation has produced a unique, interesting and instructive volume, written for the most part in language readily understood by any person of fair education and intelligence. The authors state in their Preface that the method of treatment employed was considered as "best suited for general readers, mothers, nurses, public health officials, and others interested in health, as well as for many scientific men not specializing in the subject, including physicians, hygienists, biologists, and physiologists."

After chapters on the nature of light and radiation, and on climate and the human race, there is a long succession of chapters on light in relation to life in general and then as regards its more specific effect on the blood, skin, glands, skeleton, muscles, nerves, viscera. Some of the broader aspects of the subject are then taken up in chapters on light and hygiene and the senses. The concluding chapters are entitled: Psychological Effect of Light and Lighting for Health and Happiness, the latter including such practical topics as glare in relation to eye-strain and visibility, the effect of bad and good lighting on production in industry, and the relation of lighting to the safety of human beings.

The book deserves commendation both to the general reader and to the special classes mentioned in the foregoing quotation from the preface.

Higher Surveying Revised

THE PRINCIPLES AND PRACTICE OF SURVEYING, Volume II; Higher Surveying—By Charles B. Breed, Professor of Railway and Highway Engineering, and George L. Hosmer, Professor of Geology, both of Massachusetts Institute of Technology Third Edition. New York: John Wiley & Sons, Inc; London: Chapman & Hall, Ltd. Flexible; 5 x 7 in.; pp. 489; 164 line cuts; tables, index. $3.50.

A welcome addition to the present edition of this well-known work is a 32-p. chapter on Aerial Photographic Surveying, in the preparation of which the authors have had the benefit of suggestions from Gerard H. Matthes, consulting engineer, New York City. The chapter on Triangulation "has been rewritten to accord with present geodetic practice" and the chapter on Astronomical Observations for Azimuth "has been extensively changed so that all formulas and calculations are consistent with the new (1925) arrangement of the Ephemeris and Nautical Almanac." In addition, changes have been made in the chapters on Trigonometric Leveling and Hydrographic Surveying.

Statistics and Statistical Method

AN INTRODUCTION TO THE METHODS OF ECONOMIC STATISTICS—By William Leonard Crum, Assistant Professor of Statistics in Harvard College, Director of the Statistical Laboratory of the Harvard University Committee on Economic Research; and Alson Currie Patton, Actuarial Department, Phoenix Mutual Life Insurance Co., formerly Instructor in Statistics, Yale University. Chicago and New York: A. W. Shaw Co. Flexible; 6 x 9 in.; pp. 493; 147 charts, many tables, bibliography, logarithms. $6.

STATISTICAL METHOD—By Harry Jerome, Assistant Professor of Economics, University of Wisconsin. New York and London: Harper & Brothers. Cloth; 6 x 9 in.; pp. 395; 41 charts, 69 plates; 15 appendix tables, tables of logarithms, lists of symbols and formulas; index. $4.

ELEMENTS OF BUSINESS STATISTICS—By Robert Riegel, Ph.D.; Professor of Insurance and Statistics in the Wharton School of Finance and Commerce, University of Pennsylvania. New York and London: D. Appleton and Co. Cloth; 6 x 8 in.; pp. 549; 124 graphical diagrams, tables of logarithms, index. $4.

The three books on economic statistics, statistical method and business statistics listed above are intended to serve different classes of readers, as their titles imply and as is indicated more fully in what follows. The books are named in the reverse order of their simplicity of treatment, or with the simplest last. This implies nothing as to relative intrinsic merit. Each volume is suited to the needs and capacities of a different class of readers, and must not be judged on its own merits—and each is distinctly meritorious in its chosen field. The first book is planned for students of economic problems, the second for students of economics and sociology, and the last for business men. The first requires some familiarity with algebra and logarithms, the second somewhat less mathematics, and the last has the minimum of mathematics to arouse the opposition of business men.

"Economic Statistics" treats in order secondary and primary data, construction of tables, charting of various series, the computation of averages, correlation, analysis of time series, and forecasting. It is replete with charts and tables illustrating the various methods described, and includes methods of recent development.

"Statistical Method" embraces substantially the same comprehensive subject matter. However, it defers consideration of the sources and collection of statistics to the latter portion of the book. This is done because in the experience of the author little interest is placed in where to get data, before something is known about how to use it. The same practical considerations guide the choice of language and the simple mathematical explanations used.

"Elements of Business Statistics" is well suited to its purpose. Simplicity of language has been carried so far as to leave almost no word in the index or text which is not familiar to most readers, as is also the minimum of mathematics employed. At the same time practically the same comprehensive range of subjects is covered as in the other two books.

The civil engineer or contractor who has used the statistics on the construction industry published regularly in *Engineering News-Record* will appreciate the helpfulness of a textbook, such as any one of the above three books, in conducting the business side of his profession. Not only will the statistics of his industry take on a more interesting aspect, but they will mean more to his individual business, with a broader grasp of the whole subject of statistics to back them. Take the question of winter building. If the improvement sought for in the past few years has come about in any measure, it should be revealed first in the records of the more progressive concerns, and then in the statistics of the whole field. The profit element in this consideration alone is so alluring that some one connected with the business side of every engineering organization might well be delegated to devote part of his time to analyzing the statistical evidence for the benefit of the executives. The purchase of material, likewise, has as fundamental an influence upon profits as does the bidding for contracts, particularly where a leeway of from one to three months is possible in actually placing the purchase orders. Statistics of cost prices and trends serve as groundwork for knowing when to buy. Then the general influence of business upon construction has not yet been satisfactorily indicated in quantitative terms. Correlation is the statistical name for the relation between two sets of facts. Needless to say, the enterprising organization first to seek out such relationships will be the first to reap from the forehanded knowledge of business conditions.

British Roof Coverings and How Fastened

ROOF COVERINGS: THEIR MANUFACTURE AND APPLICATION: Being a Description of the Origin, Nature, and the Method of Fixing the Various Materials and Substances that are Employed for Covering the Roofs of all Classes of Buildings—By Ernest G. Blake, M.R.S.I., A.B.I.C.C., Author of "Building Repairs," "Damp Walls," "Plumbing," "The Seasoning and Preservation of Timber," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 264; 144 halftones and line cuts. $3.50.

A well written description of a great variety of roof covers and of methods of fastening them is given in this volume. Naturally, since its author is an Englishman and is writing more particularly for his fellow countrymen, the book chiefly deals with British materials and practice. Illustrations are freely used. These are well chosen and are largely in the form of sketches showing roofing materials and methods of laying and fastening them.

After an introductory chapter on the character and properties of a roof covering, the author takes up in succession: Thatched, Organic, Metallic, Mineral and Manufactured Mineral Coverings—a chapter to each; Asbestos, Cement, Bituminous Felt, Asphalt, Glass, and Cement-Concrete. The 14 pp. given to thatching shows that thatching is not so much in disuse in England as reports reaching this side of the water would indicate. The author does state, however, that thatching is now done chiefly as repair work. The author gives a dozen pages to shingles and shingling practice, although here again he makes it clear that the use of wood shingles is now usually confined "to church spires and roofs, ornamental pavilions, and buildings of a similar nature," so far as England is concerned.

Throughout, the author seems thoroughly conversant with his subject. So little has been brought together on roof coverings within a single volume before that this book should be of interest and value to those engaged in building construction, not only in Great Britain and its colonies, but elsewhere throughout the world.

Industrial Museums in Europe

THE INDUSTRIAL MUSEUM—By Charles R. Richards, Director of the American Association of Museums. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 117; 46 halftone plates. $3.

In behalf of the American Association of Museums, Mr. Richards visited museums in a dozen foreign countries in 1923 and gathered material for two volumes, one on industrial museums and one on museums of industrial art. The present volume describes rather sketchily four industrial museums, outlines a working plan for a large industrial museum in the United States

and describes nine special museums in Europe—oceanography, marine, traffic, agricultural. The four industrial museums sketched are: Conservatoire des Arts et Métiers, Paris; The Science Museum, London; The Deutsches Museum, Munich; The Technical Museum, Vienna. Halftones interesting in subject and handsome in execution add to the appearance and value of the volume, which is notable also for fine typography and press work.

Classified Digest of Utility Decisions

GUIDING PRINCIPLES OF PUBLIC SERVICE REGULATION —By Henry C. Spurr, Editor *Public Utility Reports*. Vol. II. Rochester, N. Y.: Public Utility Reports, Inc. Cloth; 6x9 in.; pp. 750. $7.50.

The second volume of this classified digest of Public Utility Commission and of Court Decisions opens with a brief section on pavement over mains and continues with summaries of decisions on land and buildings, properties of utility companies, depreciation in its various aspects, return and its ascertainment, and operating expenses. The first volume in the series was noted in these columns Oct. 15, 1925, p. 644. The usefulness of the series to those concerned with utility problems is self-evident.

All About the Bureau of Standards

THE BUREAU OF STANDARDS: ITS HISTORY, ACTIVITIES AND ORGANIZATION. By Gustavus A. Weber. [Institute for Government Research, Service Monographs of the U. S. Government, No. 35.] Baltimore, Md.: The Johns Hopkins Press. Cloth; 6x9 in.; pp. 299. $2.

The very interesting historical section of this monograph fills 77 pp. It begins with the provision of the Constitution which vests in Congress the sole power of "fixing the standards of weights and measures in the United States," and takes up recommendations to that end by Washington and Jefferson, the latter in a notable report as Secretary of State, dated July 4, 1790. Interwoven with this section are accounts of action on standards of weight and measure in foreign countries. A lengthy section on Activities follows the one on History, after which comes a section on Organization. Appendixes deal further with both organization and activities, besides taking up the publications, equipment and controlling laws of the Bureau of Standards, and summarizing the financial statements of the bureau. A bibliography is included. The volume is one of the best in the series.

Public Health Law and Administration

PUBLIC HEALTH LAW: A Manual of Law for Sanitarians—By James A. Tobey, M.S., LL.B., Lecturer on Public Health Law at the Massachusetts Institute of Technology, Yale School of Medicine and Columbia University; Member of the Bar of the District of Columbia and of the United States Supreme Court; Fellow, A.P.H.A. With a Foreword by Charles V. Chapin, M.D., Sc.D. Baltimore: The Williams & Wilkins Co. Cloth; 6 x 9 in.; pp. 304. $4.50.

In going beyond the presentation of an up-to-date review of what may be termed the legal foundation of public health into the practical field of health administration, more particularly as regards current practice and ideals, the author has made his book of more direct value to public health officials and those who wish to follow some of their most trying problems than he would have done had he confined his treatise to health law alone.

After considering what law is and what public health is today, the author takes up the sources of public health law, the police power, state and local health departments, and some of the special powers of the latter. He then considers communicable diseases, nuisances, sanitation, social and mental hygiene, health officers and employees, liability of municipalities and health officers in this field, health legislation and how to draft it, and law enforcement. The final chapter sums up the whole matter. Among the useful and pertinent appendices is a reprint of the Constitution of the United States.

The Foreword by Dr. Chapin is what those who know him would expect from this eminent authority, who for nearly a half century has been health officer of Providence, R. I., and a national figure in public health administration. The book deserves a hearty welcome and a wide use.

PUBLICATIONS RECEIVED

ANALYSES OF ALABAMA COALS may be had for 15c. from Superintendent of Documents, Washington, D. C. The compilation has been made by the U. S. Bureau of Mines.

THE WORLD ALMANAC for 1926 contains 886 closely filled pages of useful information along well-known lines (from the New York World, postpaid, for 60c. in paper or $1.10 in cloth).

AN ILLUSTRATED ACCOUNT of the Hetch Hetchy Water Supply project, by M. M. O'Shaughnessy, city engineer of San Francisco, Calif., and chief engineer of the project, has been printed as a 47-p. pamphlet, dated October, 1925.

A PAPER AND DISCUSSION on inspection and testing of railway material is available as a reprint from the *Proceedings* of the Canadian Railway Club for Dec. 8. The paper is by Robert Job, vice-president, Milton Hersey Co., 84 St. Antoine St., Montreal, P. Q.

REGULATIONS of the National Board of Fire Underwriters for the storage and handling of combustible fibres, as recommended by the National Fire Protection Association (Boston, Mass.) makes up a handy little pamphlet of 23 pages.

THOSE HAVING TO WRESTLE with labor problems will find useful the bulletin of the U. S. Bureau of Labor Statistics, entitled "Trade Agreements, 1923 and 1924." Some 15 pages are devoted to the building trades (15c. from Superintendent of Documents, Washington, D. C.).

COMMERCIAL STATISTICS for the calendar year 1925, compiled by the Statistical Division of the Board of Engineers for Rivers and Harbors as a part of the 1924-25 Report of the Chief of Engineers, U. S. A., extends to 1,275 pp. giving details of the water-borne commerce of the United States.

TRINITY RIVER POLLUTION STUDIES, a paper reprinted from the *Southwest Waterworks Journal* for December, 1925, summarizes investigations made under the direction of Dr. H. O. Sappington, state health officer, and V. M. Ehlers, chief sanitary engineer of the Texas Department of Health during 1924-25.

VARIOUS PAPERS AND REPORTS of the members of the technical staff of the Maryland State Department of Health (Baltimore, Md.) have been issued as Engineering Bulletin 2. Some of the material is reprinted from various sources, including *Engineering News-Record*. Abel Wolman is chief engineer of the board.

ENGINEERING UNDERTAKINGS SINCE 1921 of the China International Famine Relief Commission are outlined and illustrated (line drawings and halftones) in a pamphlet issued by the commission at Peking, China. O. J. Todd is chief engineer and T. Y. Yang is assistant engineer to the commission.

COMPARATIVE TAX RATES of 215 of the larger cities of the country have been gathered and tabulated by C. E. Rightor, director of the Detroit Bureau of Government Research, and are now available as a reprint from the

December issue of the *National Municipal Review* (261 Broadway, New York City).

THE ILLINOIS STATE WATER SURVEY has issued *Bulletin* 21 on *Public Ground Water Supplies in Illinois* (910 pp.) by G. C. Habermeyer, being a summary of investigations for several years past of quantity and quality of ground waters available throughout the state. The information from municipal officials, well drillers and engineers, compiled under the direction of Dr. A. M. Buswell, director of the survey, is included along with work done by the State Water Survey. Surface water supplies are listed but not described.

INDUSTRIAL PSYCHOLOGY, with the subtitle, "Journal of Human Engineering," is now being published at Hamilton, N. Y. (50c. a number or $5 a year). The first of January issue has among other contributions one on Control of Office Output, by Wallace Clarke, consulting management engineer, New York City; one on Handling Men Through Their Self-Interests, by Glenn L. Gardiner, now in charge of foremanship training for the Oakland Motor Co., and one entitled A Correlation Machine, by Stuart C. Dodd, of the Gardiner School of Princeton University.

STILL INTERESTING though much belated in publication is the report of the United States Coal Commission, transmitted to Congress in December, 1923—and not yet acted upon by that body, except to order the document printed 14 months after the date of transmission. The report is in five parts with a separate volume for each part: (1) Principal Findings and Recommendations, including "Recommendations for Legislation," which fill some 24 pp.; (2) Anthracite; (3 and 4) Bituminous; (5) Statistical Tables. Those wishing to obtain a copy of the report should apply to their senator or representative in Congress.

THE WANAQUE WATER SUPPLY PROJECT for the benefit of Newark, Paterson, Passaic, and near-by municipalities is described in a report just issued by the North Jersey District Water Supply Commission (Newark, N. J.). The report covers not only the Wanaque project, but also the history of the commission from its creation in 1916 to the middle of 1925. In addition, much information is given regarding the water supply of the section of New Jersey indicated and schemes are outlined for supplying six counties of the state. Arthur H. Pratt is chief engineer and Morris R. Sherrerd is consulting engineer.

EX-LIBRIS, described in its subtitle as "A journal devoted to the professional interests of business, agriculture, engineering, and the social sciences," appeared for the first time in November. The principal articles in the initial number are: The Harvard Business Reports, by Wallace D. Donham, dean of the graduate school of business administration, Harvard University; Training for the Real Estate Business, by Richard T. Ely, director of the Institute for Research and Land Economics and Public Utilities; and The Raw-Material Market, by J. Anton de Haas, professor of foreign trade, New York University. There are also a couple of pages of Personals, and 4 pp. devoted to a listing of new books with excerpts from reviews of the books published elsewhere. The new journal is to be a quarterly, issued by the A. W. Shaw Co., Chicago—apparently for free circulation.

TWO WORTH-WHILE ADDITIONS to the literature of earthquake resisting construction are presented in pamphlets just issued. A. C. Alvarez in a brief summary statement (The Santa Barbara Earthquake of June 29, 1925; University of California, Berkeley, Calif.) gives conclusions respecting the showing of different constructional elements and types in the Santa Barbara earthquake, agreeing well with conclusions which other engineers have reached. His statements, and in particular a number of halftone illustrations given as separate plates in the pamphlet, merit inclusion in any reference file on earthquake experience. H. M. Hadley's argument (The Essentials of Earthquake-Proof Construction; Portland Cement Association, Chicago, Ill.) is somewhat more general. While it takes the Santa Barbara earthquake as its direct subject, the statement of essentials of earthquake-proof construction which he gives is based quite as much on the experience of Tokyo and Yokohama. This statement, by the way, is as simple and clear as the reader will find anywhere, and gives the pamphlet a claim on the attention of every structural engineer and architect.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

A HISTORY OF ECONOMIC PROGRESS IN THE UNITED STATES—By Walter W. Jennings, Ph.D., Associate Professor of Economic History in the University of Kentucky. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 819; 1 map, statistical tables, bibliography. $4, postage extra.

HISTORY OF THE DELAWARE AND HUDSON COMPANY, 1823-1923: A Century of Progress. New York: The Delaware & Hudson Co. Cloth; 6x8 in.; pp. 755; 210 halftones.

INDUSTRIAL WATER SUPPLIES OF OHIO, with Chapters on Impurities in Water, Methods of Analysis and the Statement of Results and Their Interpretation, the Behavior of Water in Use, and the Industrial Purification of Water—By C. W. Foulk, Professor of Analytical Chemistry, The Ohio State University. Columbus, Ohio: Geological Survey of Ohio. Cloth; 6x9 in.; pp. 406; data tables. $1.

As hinted by the subtitle, this compendious volume contains detailed analyses of both surface and ground waters of Ohio, which should prove useful within and at least interesting outside that state—as should the entire contents of the book.

MARKETING—By Edmund Brown, Jr., Ph.D., Member Consulting Board, Brookmire Economic Service, Inc., Formerly Associate Professor of Marketing, University of North Carolina. New York and London: Harper & Brothers. Cloth; 6 x 9 in.; pp. 503; 6 halftones; statistical tables. $3.

MECHANICAL WORLD YEAR BOOK: 1926. Manchester and London: Emmott & Co., Ltd. Cloth; 4 x 6 in.; pp. 348; 103 line cuts; tables. 1s. 6d. in Manchester.

LES MÉCANISMES—Par G. H. C. Hartmann, Chef des Travaux de Mécanique a L'École Polytechnique, Avec le Patronage de la Société des Ingénieurs Civils de France et de la Société d'Encouragement pour l'Industrie Nationale. [Encyclopédie de Mécanique Appliquée, Publiée sous la Direction de M. L. Lecornu, Professeur a L'École Polytechnique et a l'École Nationale Superieure des Mines, Membre de l'Institut.] Paris: Librairie J.-B. Balliere et Fils (19, Rue Hautefeuille). Paper; 6 x 9 in.; pp. 452; 388 line drawings.

MEMOIR OF FLEEMING JENKIN: RECORDS OF A FAMILY OF ENGINEERS—By Robert Louis Stevenson. [South Seas Edition, Vol. XVI.] New York: Charles Scribner's Sons. Cloth; 5 x 7 in.; pp. 352. $0.90.

THE MINISTRY OF HEALTH — By Sir Arthur Newsholme, K.C.B., M.D., F.R.C.P., Principal Medical Officer Local Government Board, England and Wales, 1908-1919, merged in the Ministry of Health. London and New York: G. P. Putnams Sons, Ltd. Cloth; 5x8 in.; pp. 271. $2 (5s. net in London).

MODERNE ENGELSCHE INZICHTEN OMTRENT RIOOLWATERREINIGING — Door F. C. J. Van den Steen van Ommeren, Adj.-Directeur der Gemeentewerken. Reprint from Bouwbedrijf, Maanblad voor Bouwkunde, Techniek en Handel. The Hague (Holland): N. V. Moorman's Periodical Press. Paper; 6x9 in.; pp. 50; 20 line cuts and halftones.

Describes various British sewage-works in some detail.

NORTH AMERICA: Its People and the Resources, Development, and Prospects of the Continent as an Agricultural, Industrial, and Commercial Area—By J. Russell Smith, Professor of Economic Geography, Columbia University, Author of "Industrial and Commercial Geography," "Commerce and Industry," "Human Geography." New York: Harcourt, Brace & Co. Cloth; 6 x 9 in.; pp. 849; 410 line cuts and halftones. $6.

SIR EDWIN CHADWICK (1800-1890)—By Maurice Marston. Boston: Small, Maynard & Co.; London: Leonard Parsons. Cloth; 5x8 in.; pp. 186; frontispiece portrait.

SIX-PLACE TABLES: A Selection of Tables of Squares, Cubes, Square Roots, Cube Roots, Fifth Roots and Powers, Circumferences and Areas of Circles, Common Logarithms of Numbers and of Trigonometric Functions, Natural Trigonometric Functions, Natural Logarithms, Exponential and Hyperbolic Functions, and Integrals—With Explanatory Notes by Edward S. Allen, Associate Professor of Mathematics, Iowa State College. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Flexible; 4x7 in.; pp. 144. $1.25.

Designed particularly for "those teachers who wish their students to learn the ready use of six-place tables." The first edition was reviewed in *Engineering News-Record*, Oct. 19, 1922, p. 666.

SUPERPOWER: ITS GENESIS AND FUTURE—By William Spencer Murray, Murray & Flood, Engineers; Engineering Chairman, U. S. Government Superpower Survey. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 237; 5 insert map plates, 25 line charts. $3.

TRAVELERS' MEDICAL GUIDE AND MANUAL, 1926—Compiled by William Bierman, M.D., Medical Advisor, National Council of Traveling Salesmen's Association. Published for The National Council of Traveling Salesmen's Associations. New York: Travelers' Medical Guide, Inc. (293 Central Park West). Flexible; 3 x 6 in.; pp. 115 plus memorandum space. $1.

Vest-pocket directory of physicians in "a thousand traveled towns" of United States and Canada, with their specialties, office hours and telephone numbers.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Concrete Admixtures

Sir—The comments of C. N. Conner in his article "Concrete Improved by the Use of Diatomaceous Earth," in your Dec. 17, 1925, issue, p. 995, with reference to the use of oversanded mixtures in concrete suggest several points which are worthy of further discussion.

So far as I am aware the term "oversanded" was first used by the Bureau of Standards in 1919 to designate concretes in which the fine-coarse aggregate ratio is greater than 0.5, a value generally employed in concrete work to give proportions such as 1:1½:3, 1:2:4, etc.

With Potomac River aggregates, generally used in concrete construction work in the District of Columbia, tests indicated that a sand-gravel ratio of more than 0.5 resulted in concretes of higher compressive strength which were more easily placed and showed much less tendency to segregate in the wetter consistencies often necessary in structural work. For some deliveries of fine aggregate a sand-gravel ratio as high as 1.0 gave best concretes while for other lots any increase *over 0.5* appeared to reduce compressive strength. It was apparent that the fineness of the sand, most conveniently measured and expressed by surface area, was the important factor in these variations. Sands having surface areas of less than 700 sq. in. per 100 grams permitted the use of the 1.0 ratio, while sands approaching 1,100 sq. in. per 100 grams gave best results in about a 0.5 ratio. Repeated tests showed such "oversanded" concretes to be superior in every respect and also slightly more economical owing to their greater yield and the lower cost of sand per cubic yard.

"Oversanding" has proven even more beneficial in concretes made with Saskatchewan aggregates used in the two largest cities of the Province. The pit run gravels contain from 60 to 90 per cent fine aggregate in which the percentage of particles passing the No. 50 sieve is usually low. Surface areas of fine aggregate range between 350 and 500 sq.in. per 100 grams. The best quality concretes are made with a sand-gravel ratio which varies from 1.0 to 1.5. These concretes are far more easily placed and are stronger than mixtures which conform to the old 2:4 and 3:6 ratios. Incidentally these oversanded concretes require a greater quantity of mixing water in the batch, are *less dense* but are *more watertight or impermeable*, which further illustrates the lack of relation between density and watertightness, best evidenced by the fact that neat cement is lower in density than other concrete, but is impermeable. As the result of laboratory and field experience with these aggregates we are now recommending the use of pit-run aggregate in general concrete construction work with 60 per cent sand by weight as the basic proportion and with provision for decrease in aggregate quantity in the batch for higher sand contents which are determined at intervals by the use of a No. 4 screen and small balance.

With cement content constant, working qualities of concrete may be improved either by (1) "oversanding" or, (2) by use of a finer sand or modifying a coarse sand by the addition of fine particles of sand or more finely powdered materials such as hydrated lime, celite, etc. In (2) the finely powdered admixtures are no doubt much more efficient volume for volume than fine sand particles. The use of either method (1) or (2) requires more mixing water in the batch if consistency or flowability is to be kept constant. For structural concretes I have never encountered a case of lack of workability or segregation due to coarse sands which could not be corrected by change of sand-gravel proportions or "oversanding," at the same time maintaining flowability and strength without the use of additional cement. In road concretes the "trowelling" workability, a factor of little or no importance in structural concretes, is a necessary characteristic and can possibly be best obtained where sands are deficient by the use of some type of powdered admixture, or by a combination of "oversanding" and admixture. As Mr. Conners has pointed out, such additions will increase yield and decrease density, but this density change is not usually important.

In connection with compression tests of concrete cores removed from pavements the possible variation of strength in different planes below the surface is worthy of study. The average strength of the concrete as determined by tests of full length cores is of value but it is questionable whether this strength is representative of that portion of the concrete at and below the wearing surface. The usual road concrete, having a high percentage of mortar and compacted and finished by heavy tampers, the vibrolithic method, or rollers of the heavy wire mesh type, has a mortar surface of very appreciable thickness containing a smaller percentage of coarse aggregate and may have a compressive strength much higher than that of the body of the concrete. The result may be a wearing surface of considerable thickness much stronger where wear and flexural stresses are highest than the average values obtained from the core tests.

It has been my experience that "oversanded" concretes are best for structural purposes when the fine aggregate lacks the smaller particles and that unless "oversanding" is employed the aggregates are not being used to the best advantage. For concrete highway construction it is possible that "oversanding" may not be so advantageous under all conditions and the use of admixtures may prove more economical. In any case definite conclusions as to the merits or deficiencies of each may be drawn from a small series of properly planned laboratory tests, followed up by tests and observations of the concretes when used under field conditions.

G. M. WILLIAMS,
Professor of Civil Engineering,
University of Saskatchewan.
Saskatoon, Sask.,
Jan. 7, 1926.

Sir—I am interested in the letter by T. P. Watson in *Engineering News-Record*, Dec. 31, 1925, p. 1084. It comments on an article by C. N. Conner, "Concrete Improved by the Use of Diatomaceous Earth," in the issue of Dec. 17. I agree with Mr. Watson in his statement that it would be valuable to compare what is called widely divergent viewpoints.

Theories regarding the proportioning of concrete materials may be either of a leading or misleading nature. It is only by the publication of test data that opinions and facts may be differentiated. It appears to me that sufficient test data were given in the article in question to support conclusions where drawn. The investigation was based on laboratory tests and is sufficiently complete to allow the formation of other conclusions if justified. Data of similar nature are missing from Mr. Watson's discussion, and it is, of course, impossible to form an unbiased opinion on the subject unless data are offered in return, both as a means for criticism and to substantiate conclusions.

General discussion and conclusions regarding admixtures, without classification or test data, applied to an article including a great number of tests of a single admixture, seem beside the point and might be construed as more of an attempt to justify a much disputed theory. I feel that such criticism indicates a lack of understanding of the purpose for which various admixtures are intended. I also feel that the interests of better concrete and a better understanding in general, would justify a request for, as well as the publication of, test data and discussion in answer to such questions as suggested by reading the letter submitted by Mr. Watson.

Paragraph 2. (a) In what publications do the Bureau of Standards and the Structural Materials Research Laboratory agree with his experience that the compressive strength of concrete used in reinforced-concrete bridges is dependent on "the ratio of the volume of water to the volume of cement in the mixture regardless of proportions, with or without admixtures"? I am unable to place such publications or tests and do not have his data on the subject.

(b) With a given quantity of cement, and aggregate, with or without admixtures, what explanation was found to account for decreased compressive strength due entirely to an increase in water content, or change in water-cement ratio, above this given quantity?

Paragraph 3. (a) How was maximum workability determined?

(b) How was uniformity tested rather than judged?

(c) How many of the 1,000 5 x 12-in. cylinders contained admixtures? How many contained the material mentioned in Mr. Conner's article?

(d) What allowance was made for the well-recognized variation in field testing? At the rate of but a single cylinder per 40 cu.yd. of concrete, the testing must have been carried on over an extended period of time. Such a period would subject specimens to a number of variables, any one of which would have an effect far greater than that recognized in suitable admixtures when used in proper mixtures and amounts. Was any consideration given to average strengths?

Paragraph 4. What is considered a satisfactory workability with respect to greatest economy and its effect on uniformity?

Paragraph 5. Although this paragraph appears to be indefinite and more of a commercial than technical nature, it should be stated how additional cement increases the density of concrete. Such a statement is open to question.

Paragraph 7. For general concrete knowledge, test data by way of explanation would be necessary.

Many additional questions could be asked which, if answered, might serve to support the conclusions which do not coincide with the research of others who have spent considerable time investigating identical problems. Further discussion will undoubtedly be of interest to the many students and users of concrete as well as of suitable admixtures. Admixtures in concrete constitute what might be called advanced study. In such work it becomes necessary to agree or to remove certain predetermined theory or theories which might have been influenced by research of other nature.

Conclusions from research work are drawn at times without sufficient detail to support them. Proper interpretation of conclusions will warrant a study of the detail forming such conclusions. This requires much more time than the average engineer can give. The subject involves many inter-relations between the factors affecting concrete in place. Intelligent and unbiased opinion requires familiarity with factors which might be considered as outside the normal field. Such factors have possibly an unseen but definite bearing on the subject. Without consideration of such knowledge it is decidedly unfair to discuss a subject of as great importance as admixtures.

G. W. HUTCHINSON,
Manager, Concrete Dept., Celite Products Co.,
Chairman, Sub. Com. IX on Admixtures,
New York City, Com. C 9, A.S.T.M.
Jan. 4, 1926.

Much Ado About an Election

Sir—The editorial, under the above caption, in your issue of Dec. 31, 1925, p. 1057 is timely and to the point.

Much of the trouble and about all of the fuss which has gradually grown up about the subject is due to the habit, for it appears to be little else, which has been contracted whereby the nominating committee limits the nominations to one name for each office to be filled. This virtually makes the nominating committee the election body and the many proposed amendments to the constitution to say nothing of the increasing number of primary, tertiary, and so on *ad infinitum* ballots are mere symptoms of this trouble.

To a member of the society living outside the United States and not a citizen, this truly American habit of prolonging an election fight has always been looked on with some wonder tinged with a little amusement. They seem to go such a long way round to climb a very small hill. Why limit the nominations to but one name for each office? Why not let them all come? Provided would-be condidates can get the endorsement of a set number of members, which would vary with the importance of the office, let as many names be submitted as wish to stand. Then let the list be submitted to vote by the transferrable system and from the first ballot select the first three, or two, and submit these to a second final ballot, also on the transferrable system where there are more than two names for the office. With this system there would be no need for the nominating committee, which might in itself be a blessing.

The transferrable vote has been objected to as un-American, un-democratic, unworkable and many more things which are not so. About the only objection which has proved valid in practice is that it lends itself to the formation of groups. This *is* an objection in parliamentary affairs. If it holds in the society it is a symptom of deeper trouble which should be corrected. There is nothing to be gained by trying to suppress the symptoms.

Jan. 6, 1926. Σατυρικον.

29-Ft. Concrete Arch Sewer at Richmond

Sir—In reference to the article in your publication of Dec. 17, 1925, p. 996, on the building of a 29-ft. concrete arch sewer at Richmond, Va., I believe that it would prove of interest to make certain observations in regard to this construction and design and to correct certain impressions that might result relative to the design of such structures.

It is stated in your article that the invert is of heavy design, at least of a design heavier than that commonly in use, due to the comparatively flat arch section necessary because of limited headroom. It is true that the invert is of heavy design because of the inclined thrust produced by a flat arch section, but it is not a fact that this design is more substantial than that in ordinary use for inverts, even where the ratio of rise to arch span is more favorable than in this case. The invert merely appears heavy or substantial in the cross-section because of the comparative thinness of the arch ring proper. I have had occasion to examine the contract drawings of similar structures for various cities and I am certain that this statement can be substantiated. For instance, the invert thickness is 35 in. for the Wingohocking sewer recently let to contract in Philadelphia, for which the arch span is 24 ft. and the rise 21 ft.

The real point in question in regard to these structures is whether the structure should be designed as an elastic ring throughout, with the inclusion of the invert, or whether it would be more advantageous to consider as separate the arch ring proper and the invert. Can we consider the arch ring proper as an elastic unit with virtual fixation at its junction with the invert? This depends entirely upon the nature of the material to be encountered in the foundation. In order to settle this point before construction was undertaken, a model of the proposed Shockoe Creek design was constructed on a one-fourth scale on the actual foundation upon which the finished structure was to be laid. This model was subjected to a loading test of 3,000 lb. per square foot. We developed from this experiment that for the small deflections experienced on this particular foundation the design of the arch ring proper on the basis of a practical fixation at the invert line was sufficiently strong. There was no indication whatever of any distress in the arch ring. Therefore the invert was designed:

1. To resist the outward thrust of the arch ring (this is due to the comparatively flat arch section) very noticeable under certain conditions of loading.

2. To take up the actual elongation produced by deflection of foundation.

3. To withstand the bending at the center of the invert induced by deflection of the foundation on the assumption that the load would increase uniformly from zero at the center of the invert to the maximum allowable load on the foundation at the edge of the invert.

There is no question that there is a very considerable economy under the above assumptions of design where the foundation is resistant—firm clay, gravel or shale.

In this connection, it might be remarked that in the new large arch sewers designed for Kansas City and St. Louis, in order to avoid the cost of heavy invert construction, there is a separation of the invert from the arch ring. Such a separation, of course, involves spread footings under the arch rings and a heavier design of the arch ring proper. These sewers, however, are fully as economical in design as the Shockoe Creek section. They are certainly worth the serious consideration of designers, although it is my opinion that a thoroughly tied-in structure with substantial invert design, on the principles stated above, is just as economical, and, further, eliminates internal water pressure and possible distortion due to lack of integral rigidity.

The Shockoe Creek arch sections were designed under the supervision of Allen J. Saville, former director of public works at Richmond. They were constructed under the direction of Col. R. Keith Compton, present director—the present writer being in direct charge of design and construction.

THOMAS TOWLES,
Design Engineer, Chief, Bureau of Design,
Richmond, Va., Department of Public Works.
Dec. 23, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

George S. Davison Elected Head of Am. Soc. C.E.

Pittsburgh Engineer and Executive to Be President of Society for Year 1926

George S. Davison, who was elected president of the American Society of Civil Engineers at its annual meeting, Jan. 20, 1926, is a native of Pittsburgh, Pa., and a graduate of Rensselaer Polytechnic Institute in the class of 1878 with the degree of civil engineer. From the time of graduation until 1882 he was in railway engineering work with the Pennsylvania R.R., Lines West, and the Atchison, Topeka & Santa Fe. Ry., and also with the U. S. Engineering Department on river work in the South and West.

In 1882, Mr. Davison was appointed chief engineer of the Pittsburgh, Chartiers & Youghiogheny R.R. which he located and constructed. While so engaged, he made surveys for connecting Pittsburgh with the Lakes, which later on led to the construction of the Bessemer & Lake Erie Railroad. From 1890 to 1900, Mr. Davison practiced engineering with William Clyde Wilkins under the firm name of Wilkins and Davison. During this connection they directed many engineering undertakings of many types in and about Pittsburgh including coking plants, bridges, railroads, electric railways, steel plants, water works and town layouts.

In 1897, Mr. Davison became chief engineer of the Monongahela Street Ry. System, later he built the Pittsburgh and Charleroi Street Railway. In 1901, Mr. Davison became the general manager and director of the Pittsburgh and Birmingham Street Railways. As consulting engineer for the U. S. Steel Corporation and the Pennsylvania Railroad in 1902, he made a relocation of the Monongahela R.R. between Uniontown and the Monongahela River in Fayette County, Pa.

In 1905 and 1906 he constructed the Allegheny Valley Street Ry. from Aspinwall along the Allegheny River to Natrona.

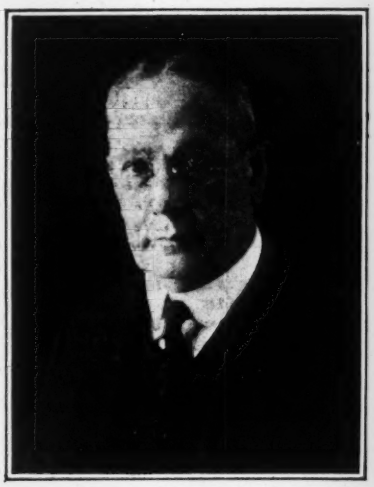
In 1904, he entered the services of the Gulf Refining Company, of which company he is now President. In the latter part of 1906, he initiated locations for an oil pipe line extending from Tulsa, Oklahoma, to the Gulf coast at Port Arthur, Texas, a distance of five hundred miles, designing and constructing its pump stations. In 1910, he designed and had direct charge of the construction of the mile and one-mile extension of the Port Arthur Ship Canal.

Mr. Davison is secretary and member of the Engineering Committee of the Flood Commission of Pittsburgh, of the executive committee of the Citizens' Committee on City Plan of Pittsburgh, a member of the Planning Commission of the City of Pittsburgh and chairman of the Transit Commission of the City of Pittsburgh.

After our entry into the war and until the end of the year he was a member of the Oil Sub-Committee of the National Council of Defense and thereafter until the end of the war of the National Petroleum War Service Committee. He is a director of the American Petroleum Institute.

Mr. Davison has been a member of the society since 1890 and has served it both as a director and as a vice president.

New President of American Society of Civil Engineers



George S. Davison

Am. Soc. C. E. Officers Elected

Canvass of the ballots yesterday showed that George S. Davison was elected president of the American Society of Civil Engineers, receiving 3,272 votes out of a total of 3,352 votes counted. Other officers and the votes cast were as follows: Vice-presidents, to serve two years, Zone 1, Allen Hazen (3,118) and Zone 4, Walter L. Huber (3,084); directors, to serve three years, Frank M. Williams, District 3 (3,046), D. H. Sawyer, District 5 (3,038), T. Chalkley Hatton, District 7 (3,037), A. J. Hammond, District 8 (3,036), Charles H. Paul, District 9 (3,040), and E. G. Taber, District 12 (3,047).

New Technical Division of Civil Engineers

Board of Direction Approves of a New Division of Surveying and Mapping

The Board of Direction of the American Society of Civil Engineers, at a meeting held just before the annual meeting of the society, approved a petition for the creation of a new technical division to be known as the Surveying and Mapping Division.

The board adopted amendments to by-laws as follows:

Reducing number of endorsers required by candidate for junior grade who is a graduate of an engineering school of recognized reputation from five to two; providing that members of graduating classes of school of engineering of recognized reputation who shall apply for admission not later than two months after graduation shall be exempt from payment of equivalent of one year's dues.

The board authorized the appointment by the president of the society of a committee of five members to form with representatives of the American Institute of Steel Construction a Joint Committee on Stresses in Structural Steel for the purpose of agreeing on a standard specification covering allowable stresses in structural steel in buildings.

Notification was received of the adoption by the Engineering Foundation of a policy for the Foundation as approved by the four founder societies. The board received from the Foundation appropriations of $2,500 for the investigation of the Special Committee on Concrete and Reinforced Concrete Arches, and $1,000 to aid the Committee on Steel Column Research.

The board authorized the appointment of a Committee on Fees and Salaries to consist of five persons, and to have a continuing function, which shall be to investigate and report from time to time as to prevailing rates of compensation throughout the profession, and is also authorized to make such recommendations to the Board of Direction as may seem pertinent.

An outstanding thing accomplished was in continuation of the recommendation of the Committee on Aims and Activities that further responsibility be placed upon the technical divisions for the carrying out of the technical activities of the society. Working from this basis, the Committee on Technical Activities and Publications presented a report recommending the formation of a new standing committee of the society to consist of the chairman of the Research Committee, chairman of the Technical Activities and Publications Committee, two directors specifically representing the Board, and the chairman of each of the technical divisions.

American Society of Civil Engineers Awards Five Medals and Prizes

CHARLES S. WHITNEY, winner of the J. James R. Croes Medal for his paper "Design of Symmetrical Concrete Arches" was born in Bradford, Pa., and graduated from Cornell University in 1914, taking a year's post-graduate work for his master degree in civil engineering. From 1915 until 1917 he was on various concrete and steel construction work including the Hell Gate bridge and Bronx viaduct for the New York Connecting Railroad. From December, 1917, to June, 1919, he served in the army, first with the 25th Engineers on light railway construction in France and later on portland cement investigations at Base Section No. 2, France. After the war he became chief engineer, A. C. Eschweiler, architect, Milwaukee, Wis., and then chief engineer and manager of the Milwaukee office, Hool & Johnson. In 1922 he left that position to open an office as consulting and designing engineer at Milwaukee, Wis.

WILLIAM M. BLACK, major general, U. S. Army, retired, who was awarded the Arthur M. Wellington Prize for his paper entitled Waterway and Railway Equivalents served as Chief of Engineers, U. S. Army, from March, 1916, until his retirement from active service in 1919. He is now a member of the firm of Black, McKenney & Stewart, consulting engineers, Washington, D. C. He is a native of Lancaster, Pa., and a graduate of the U. S. Military Academy in 1873. For a few years after graduation he served as an instructor in military engineering and then was assigned to field work with the Corps of Engineers in various parts of the country. A considerable part of this work was in connection with the construction of fortifications and he was the first to use reinforced concrete in U. S. fortification work. In 1898 he became first, chief engineer, Third Army Corps, and then chief engineer of the Fifth Army Corps. During the Spanish-American War he served for a short time as chief engineer, U. S. Volunteers. In 1898 he commanded the advance guard at the landing at Quanica, Porto Rico. Subsequently, he served as chief engineer officer in Cuba under General Ludlow and General Wood. From May to July, 1904, he was acting chief engineer of the Isthmian Canal Commission. In 1906 he was appointed advisor to the Department of Public Works, Provisional Government of Cuba, which position he held until January, 1909, and during this time he devised a comprehensive system of highways for Cuba and supervised the construction of many public works. In 1909 he became chairman of the Board of Engineers in charge of the raising of the wreck of the "Maine" in Havana Harbor, and subsequently chief engineer officer, Eastern Department, and division engineer, Eastern Division, River and Harbor Improvements.

The American Society of Civil Engineers at the opening session of its annual meeting presented the following medals and prizes:

Norman Medal—awarded to Harrison P. Eddy, consulting engineer, Boston, Mass., for his paper entitled "Imhoff Tanks—Reasons for Differences in Behavior."

J. James R. Croes Medal—awarded to Charles S. Whitney, consulting engineer, Milwaukee, Wis., for his paper entitled "Design of Symmetrical Concrete Arches."

Thomas Fitch Rowland Prize—awarded to H. deB. Parsons, consulting engineer, New York, N. Y., for his paper entitled "Sherman Island Dam and Power House."

James Laurie Prize—awarded to William Kelly, director of engineering, National Electric Light Association, New York, N. Y., for his paper entitled "The Colorado River Problem."

Arthur M. Wellington Prize—awarded to Maj.-Gen. William M. Black, consulting engineer, Washington, D. C., for his paper entitled "Waterway and Railway Equivalents."

No award of the Collingwood Prize for juniors was made, as no papers were presented by junior members.

HARRISON P. EDDY, who was awarded the Norman Medal for his paper on "Imhoff Tanks—Reasons for Differences in Behavior" is a native of Millbury, Mass., and a graduate of Worcester Polytechnic Institute in 1891. Upon graduation he became superintendent of the sewage treatment plant at Worcester and the following year was elected superintendent of the Worcester Sewer Department, which position he held until in 1907 when he went into private practice in Boston, with Leonard Metcalf. As a member of the firm of Metcalf & Eddy he has acted in a consulting capacity upon problems of sewerage and the disposal of sewage, trade wastes and refuse for many municipalities and manufacturing interests. More recently Mr. Eddy served as a member of the Engineering Board of Review, Sanitary District of Chicago.

WILLIAM KELLY, who was awarded the James Laurie Prize for his paper on "The Colorado River Problem" is a native of New York City and a graduate of the U. S. Military Academy in the class of 1899. After graduation he was assigned to the Philippine Islands for a short time and then to fortification work. Later he was again assigned to the Philippines, at which time he was in charge of electric railway construction on Corregidor Island. Upon return to the United States he served for four years as assistant engineer-commissioner, District of Columbia, in charge of water supply and sewerage systems and building inspection. Subsequently he was, for four years, in charge of rivers and harbors work in the office of the Chief of Engineers. At the outbreak of the late war he was made a member of the General Munitions Board of the Council of National Defense and in October, 1917, when to France as chief engineer of the 42nd Division. After a year of service with this division, he became chief engineer, 4th Army Corps, and later commanded Sections Nos. 7 and 9. After the armistice he was assigned to duty with the American Peace Commission. After the war Colonel Kelly was made chief engineer of the Federal Power Commission, which position he held until his resignation in June, 1925, to become director of engineering of the National Electric Light Association.

H. DEB. PARSONS, who was awarded the Thomas Fitch Rowland Prize for his paper on "Sherman Island Dam and Power House" is a native of New York City and a graduate of Columbia University in 1882 and Stevens Institute of Technology in 1884, with the degree of M. E. Since 1885 he has practiced as a consulting engineer in New York City. In 1892 Mr. Parsons was appointed professor of steam engineering at Rensselaer Polytechnic Institute and since 1907 has been professor emeritus of practical engineering there. His early practice as a consulting engineer included railroad and bridge work in Texas, the design of machinery for quarrying slate in Vermont, a hydro-electric drive for the mills of the Laflin & Rand Power Co., and consultant on design of machinery for the du Pont Company. Later he served as consulting engineer for various departments of the City of New York in which work he designed police patrol boats, fire boats, and ferry boats, also refuse incinerators. From 1908 to 1914 he was a member of the Metropolitan Sewerage Commission to report on the main drainage for the City

of New York, and in the same period he was consulting engineer for the city to appraise damages to the Ulster & Delaware R.R. due to the construction of the Ashokan dam. In 1919 he was appointed a member of the Advisory Engineering Committee to assist the Reconstruction Commission of the State of New York. In recent years he has done considerable appraisal work, having served as district appraisal officer, Air Service, U. S. Army, and having made numerous appraisals for private interests. Also, he has served as designing engineer or consultant on the design of numerous large dams and on difficult foundation work around New York City.

John Fritz Medal Awarded to Edward Dean Adams

The John Fritz gold medal, the highest honor bestowed by the engineering profession in this country, has been awarded for 1926 by the Engineering Foundation to Edward Dean Adams of New York, "engineer, financier and scientist, whose vision, courage and industry made possible the birth, at Niagara Falls, of hydro-electric power." Most of Mr. Adams' long and intensively active business life, says the announcement of the award, has been devoted to large enterprises combining engineering and finance.

The medal was established in 1902 in honor of John Fritz of Pittsburgh, pioneer in the American iron and steel industry, and is awarded annually for notable scientific or industrial achievement. Recent recipients have been John F. Stevens and Ambrose Swasey.

Pennsylvania Governor Advocates Tolls for Bridge

In a message delivered at the opening of the special session of the Pennsylvania Legislature on January 13, 1926, Governor Pinchot reversed his former position that the Philadelphia-Camden bridge should be free of toll and stated that further study of the matter had convinced him that tolls should be collected. Two bills have been prepared providing for the repeal of the act passed by the Legislature last year, and thus opening the way for agreement with New Jersey on the collection of tolls, which will permit the completion of the construction of the bridge.

As a further development of the bridge matter during the week, the Delaware River Bridge Joint Commission, at its regular meeting on January 15, arranged for a meeting January 22 for open discussion of tolls.

The present Pennsylvania law authorizes the commission to construct the bridge but provides a bridge control board to take over operation of the structure after it is completed, but with the provision that the present commission retain supervision of contracts until all construction is finished. It has been suggested that the present commission be continued in entire control until the bridge is finished and in operation.

Engineering Fifty Years Ago

From *Engineering News*, January, 1876

The "Dynagraph"

IT IS now some forty-five years since the railroad era fairly commenced in this country, and many points connected with railway resistances we are yet groping in the dark from the want of formulae deduced from practical experiments. Mr. P. H. Dudley, recently chief engineer on the Valley Road, and a gentleman who has devoted much study to matters of railroad economy during the past year, has brought into service a most valuable invention, known as the "Dynagraph." The object of the machine is to ascertain the resistances of engines, cars of different construction, and railway trains at all rates of speed upon the straight and curved portions of the track. Comparatively few experiments have been made in this country to ascertain the power absorbed in friction of the engines, cars, and trains in use. We have depended largely for information upon English and French experiments. Such information, to a great extent, must necessarily be unsatisfactory, for the good reason that the construction of the entire system of railways in those countries is materially different from our own. The conclusions to be drawn from the experiments of scientific engineers in Europe are not applicable to our roads.

Mr. Dudley has privately, and in a limited way, been operating with the "Dynagraph" for a month or two past, and the results have been such as to warrant the Lake Shore and Michigan Southern Railroad Company in offering him facilities to apply most thorough tests of its practicability and utility.

The instrument had to be constructed very strong to withstand the excessive shock due to unavoidable concussions in operating trains, yet at the same time made so that its adjustments are delicate. It was built by A. J. Johnson, one of Cleveland's mechanics, who not only designed many of the details, but carried them all out with great fidelity, and to whose excellent workmanship the success of the Dynagraph is largely due.

The Lake Shore Company propose to give Mr. Dudley every facility in their power to show the advantages to be derived from the "Dynagraph." Trial trips will be made over the entire Erie Division.

Civil Engineers Add Two Names to List of Honorary Members

By action of the Board of Direction, the American Society of Civil Engineers has added two names to its roll of honorary members. The ceremony of conferring this, the highest grade of membership, upon the two engineers named below took place at the annual meeting on Wednesday.

WILLIAM BARCLAY PARSONS

Engineer of the first subways built in New York; chief engineer of the Cape Cod Canal; member of the Isthmian Canal Commission and of board of advisory engineers to that commission; member of an advisory board of engineers to the Royal Commission, London Traffic; colonel of the 11th Engineers, and brigadier general, deputy chief engineer, U. S. Reserve Corps.

ARTHUR NEWELL TALBOT

Teacher of engineering; railroad engineer; a leader in engineering research; for twenty years active in the work of the Engineering Experiment Station of the University of Illinois and for twelve years in charge of the work of the Joint Committee on Stresses in Railroad Track of the American Society of Civil Engineers and the American Railway Engineering Association; past president of the American Society of Civil Engineers and of the American Society for Testing Materials.

Moffat Tunnel Leased to the Denver & Salt Lake

Use of the Moffat Tunnel by the Denfer & Salt Lake Railway Co. has been assured by a contract signed Jan. 6 for the use of the tunnel for a term of 50 years with the option of an additional term of 49 years. The company agrees to pay 66⅔ per cent of all interest and principal of indebtedness now outstanding and all of the operating and maintenance costs of the railroad tunnel. This statement together with one concerning an expectation of an early lease of the water tunnel by which the balance of indebtedness and maintenance will be assumed is contained in a financial report dated Jan. 15 issued over the signature of W. P. Robinson, president of the Moffat Tunnel Commission.

Receipts to date from all sources including bond sales, interest, boarding houses and commissary sales, amounted Jan. 1 to $10,829,042.02. All expenses so far have amounted to $7,724,467.94.

UNIT COSTS

The unit cost of excavation in the water tunnel and headings to date are $11.34 per cu.yd., 29c. more than the cost up to July 7, 1925, the last report, but still $5.95 less than the upset price of Hitchcock & Tinkler, Inc., contractors. The railroad tunnel enlargement cost has been reduced from the July figure of $5.10 per cu.yd. to $5.06, an increase of 36c. over the contractors upset price. Mr. Robinson states that there will not likely be much change in the above costs for the remainder of the work.

Engineering Council Meets at Washington

Elect Kimball President—Approve New Public Works Department Bill—To Study Reclamation

Election of officers, approval of a public works bill, action on a proposal to make an exhaustive study of reclamation and another on waste elimination aimed at industry and agriculture, and consideration of a nationwide engineering effort to solve traffic problems, were chief accomplishments at the annual meeting of the American Engineering Council held in Washington, D. C., Jan. 13-15. Other business included postponement of any action on the Giant Power Report until further consideration can be given it, and an address on reforestation by Dean Mortimer E. Cooley of the University of Michigan.

Officers elected were. Dean Dexter S. Kimball of Cornell University, president, to succeed ex-Gov. James Hartness of Vermont; Gardner S. Williams, of Ann Arbor, and Irving E. Moultrop, of Boston, vice-presidents; Dr. Harrison E. Howe of Washington, treasurer, and L. W. Wallace, Washington, executive secretary. Mr. Williams, Dr. Howe, and Mr. Wallace were re-elected.

Public Works Bill

The public works bill which the Council approved was that one drawn up by a public works conference held in Washington immediately preceding the meeting of the Council. This bill proposes abolition of the Department of the Interior in its present form and creation of a Department of Public Works and Domain, in which all federal public work functions will be centralized. It provides that the engineering officers of the Army may be detailed by the Secretary of War to non-military duties having to do with river and harbor improvements, the Mississippi River Commission, the California Debris Commission, or other civil functions with the approval of the Secretary of Public Works and Domain. All officers of the Army attached to the Department of Public Works and Domain would retain their military rank and succession, and receive the compensation, commutation and emoluments provided by law in the case of army officers of the same rank not detached from the regular army service.

Though the full details of reorganization have not yet been worked out, the bill in effect proposes that the Department of Public Works and Domain include the Bureau of Public Roads, the Office of the Supervising Architect, the Board of Road Commissioners for Alaska, the Rivers and Harbors Improvements, Mississippi River Commission, California Debris Commission, the Office of Buildings and Grounds of the District of Columbia, the Superintendent of State, War and Navy Department Buildings and the Rock Creek and Potomac Parkway Commission.

The bill also provides for four assistant secretaries; one to have jurisdiction over design and supervision of architectural works and construction; a second, over the design and supervision of engineering works and construction; a third over the construction work of the Department of Public Works and Domain; and a fourth having administrative jurisdiction over the public domain.

The measure embodying these features will be introduced in the House of Representatives by Adam M. Wyant of Pennsylvania and Senator Wesley L. Jones of Washington, according to the present plan.

Reclamation Study Advised

An exhaustive study of the whole reclamation problem, and the adoption of a fixed policy eliminating political influence, was urged in the report of the Committee on Reclamation. The Council referred the report to the Executive Committee with power to act. The committee report on reclamation was presented by Prof. H. B. Walker of the University of Kansas. The committee recommended that any study of reclamation should take up, first, the fundamental principle involved in a reasonably fixed policy of federal reclamation; second, it should consider an administrative plan looking toward the creation of a federal corporation, controlled by a small board of directors, authorized to administer and enforce congressional acts relating to reclamation; and third, it should consider development of a land settlement plan which may be practical under such corporate administration.

The committee recommended that the reclamation policy embody the principle that any project must justify the cost of construction and maintenance by either direct or indirect returns or both, and those sharing in the benefits, whether bona fide occupants of the land, the national government or political sub-divisions thereof, should bear the entire cost in proportion to the respective benefits obtained. It also recommended that previous to the inauguration of any project in the future there should be ascertained the producing capacity of the land, the ability of the land and the project to meet the cost of construction, operation and maintenance, and the practical occupation of the land by responsible settlers.

Waste Study Proposed

The research program having in mind elimination of wasteful methods in industry and agriculture was approved by the Council following a report of a special research committee headed by Dr. Harrison E. Howe, editor of the official journal of the American Chemical Society. Five years would be required to carry out this program of research, which proposes eight nation-wide engineering studies. The cost of this research is estimated at $335,000. These studies include waste in agriculture, waste in industries based on agriculture, waste of power, reclamation of materials waste, the engineering approach to the labor supply, training and employment of the incapacitated, industrial fatigue and the integration of industry.

The program for nationwide engineering efforts to solve traffic problems was sanctioned following the adoption of a report of the Council's Committee on Street and Highway Safety, of which W. B. Powell is chairman. The National Conference on Street and Highway Safety will soon go out of existence as a continuing body and its work will be parceled out among appropriate constituent bodies. The American Engineering Council will take over, it is planned, the engineering phases of the Conference's program, dealing particularly with the questions involving metropolitan traffic facilities and grade crossings. Important data on traffic are now being collected by local engineering societies throughout the United States, for submission to the Council's committee.

The annual dinner was held at the Chevy Chase Club Jan. 14. Principal speakers were Hubert Work, Secretary of Interior; Daniel R. Crissinger, governor of the Federal Reserve Board; and President Kimball.

Swing Bridge Wrecked in Being Struck by Steamer

Swing span of Oakland (Calif.) Estuary bridge wrecked on Jan. 7, 1926, when struck end-on by a steamer. The span was in open position when struck and does not obstruct the channel. A report of the accident was given in our issue of Jan. 14, p. 97.

Two States Approve Conowingo Water Power Project

The public service commissions of the states of Maryland and Pennsylvania have approved of the modified plans for the proposed hydro-electric power plant on the Susquehanna River near Conowingo, Md., a project estimated to cost $52,000,000. Final approval by the Federal Power Commission is necessary before work can be undertaken but this is expected in the near future and it is hoped that work will be under way in a few weeks. The general contract for the work has been awarded to Stone & Webster, Inc.

New York City Traffic Relief Committee Makes Report

The Advisory Committee on Traffic Relief appointed by the mayor of New York City made a report on Dec. 28 outlining the plans it has considered and the recommendations that it makes in regard to them. Also, "the committee is of the opinion that the carrying forward of the important work assigned to it requires a well-equipped organization, for the setting up of which no provision of funds has been made, and under these conditions it recommends that it be relieved from further responsibility in the matter." The report, divided into plans considered and recommendations made, will be abstracted later in more detail in these pages.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Portland, Ore., Jan. 19-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 20-22, 1926.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill.; Annual Meeting, Cleveland, Ohio, Jan. 26-28, 1926.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Toronto, Ont., Jan. 27-29, 1926.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

The Minnesota Federation of Architectural and Engineering Societies will hold its annual convention at St. Paul Feb. 5 and 6 and program for the meeting will soon be announced.

The Minnesota Surveyors' and Engineers' Society will hold its annual convention in St. Paul, Feb. 4 and 5, 1926, joining on Feb. 5 with the general Minnesota federation.

The Canadian National Clay Products Association will hold its annual convention in Toronto, Ont., Jan. 26-27, 1926. G. C. Keith, 51 Wellington St., W., Toronto, is secretary.

The New York State Association of Builders will hold its annual convention Feb. 3 and 4 in Rochester, with many addresses and with discussion of business and labor conditions in the state, legislation, the application of the compensation law and the relation of the industry to the general public.

The Midwest Power Conference, sponsored by the local and regional sections of the national electrical, mechanical, and mining engineering societies and of the National Electric Light Association and by the Western Society of Engineers and the National Safety Council, is to be held in Chicago at the rooms of the Furniture Club of America, Jan. 26 to 29 inclusive. The first annual **Midwest Engineering and Power Exposition** is to be held at the same time at the American Exposition Palace in Chicago, the exposition continuing through Saturday, the 30th.

Personal Notes

CHARLES A. HALBERT, engineer employed by the Wisconsin State Railroad Commission, has been appointed state engineer of Wisconsin; he succeeds Arthur Peabody, formerly state architect, who has been acting state engineer since the death of J. G. D. Mack a year ago.

GEORGE HOGARTH, chief engineer of the Provincial Highways Department of Ontario, has been appointed deputy minister of public works for Ontario. He is succeeded as chief engineer of the highways department by R. M. SMITH, a graduate of Queens University, Kingston, who for the past two years has been location engineer for the department.

EARLE HARRISON has been appointed city engineer at Schenectady, N. Y.; he had been serving as deputy city engineer, that post going now to C. E. BURLEIGH.

HENRY J. SCHWEIM has been appointed chief engineer of The Gypsum Industries, Chicago, Ill., to succeed the late Virgil G. Marani. Mr. Schweim received his engineering education at Armour Institute; he was associated with Muncie and Jensen, architects, with the National Fireproofing Co. as chief draftsman, and with the United States Gypsum Co. as sales engineer and supervisor, testing engineer, and as district manager.

R. D. GLADDING, RICHARD P. LENT and J. H. CLARK, JR., have incorporated under the name of the Gladding Engineering Company for the general practice of engineering with a main office located at Wilson, N. C.

GERARD H. MATTHES, for the past two years consulting engineer for Fairchild Aerial Surveys, Inc., New York City, announces his resignation in order to devote his time to the planning and organizing of large aerial surveys, and for the purpose also of engaging in general consulting practice. Mr. Matthes is an hydraulic engineer of thirty years experience in irrigation, water power, and flood control. In 1897 he was among the first to become identified with the stream gaging operations of the U. S. Geological Survey and the exploration of desert lands that preceded the establishment of the Reclamation Service, with which latter he was identified until 1907. He spent ten years in water power surveys, design, and construction in the Rocky Mountain and Appalachian regions, and from 1913 to 1920 was engaged in flood control engineering, first as division engineer for the State of Pennsylvania and later as hydraulic engineer for the Miami Conservancy District. In 1920 he undertook the investigation and survey of the Tennessee River for the War Department and had charge of field and office operations for three years during which he developed the system of aerial photographic mapping that has since been carried on there and found following elsewhere. In 1923 he entered the consulting field and has since devoted his entire time to the commercial development of aerial mapping in which he has attained considerable prominence.

HAL MOSELEY, whose appointment to the Texas State Highway Commission was announced in our issue of Dec. 17, was appointed chairman of the commission by the Governor. This is the first time in the history of Texas that an engineer has been appointed on the highway commission.

GEORGE H. MCMAHON, formerly assistant state engineer of North Dakota, has resigned and has gone to Okeechobee, Fla., to take charge of the office there of the engineering firm of Ruggles, Flowers, Farnum & Mason, of West Palm Beach, Fla.

Obituary

LEWIS S. LOUER, vice president and one of the owners of *Engineering and Contracting*, died suddenly Jan. 9 in Chicago at the age of 53. He was graduated in 1894 from the mechanical engineering department of Cornell University and went first with the Buffalo Forge Co. For many years he was business representative of the *Engineering Record* located in the Chicago office, leaving to go with Sweets Catalogue Service, Inc. Eight years ago he bought an interest in the Engineering and Contracting Company.

R. A. STORM, manager of the structural department of The Morgan Engineering Co., Alliance, Ohio, died there, Jan. 2, 1926. He was born in Altoona, Pa., forty-three years ago. Prior to 1901 Mr. Storm was connected with the Pittsburgh Steel Car Co. in Pittsburgh, and in 1901 he accepted a position with the Tennessee Coal and Iron Railroad Co. of Birmingham, Alabama, as assistant superintendent of the Structural Department. In the year of 1916 he accepted a position with The Morgan Engineering Co. as superintendent of the structural department.

W. R. W. PARSONS of Toronto, Ont., died Jan. 5 from pneumonia in his 48th year. He was for many years connected with the engineering department of the city of Toronto, afterwards becoming secretary-treasurer of the Parsons Construction Co. He was for some time engaged in superintending the operations of the company in Western Canada, more recently with the Massey-Harris Co. of Toronto.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Road Show Bigger Than Ever

Available Space Again Too Small and Several of the 288 Exhibits Had to be Held on Adjacent Lots—Trends of Equipment Design Follow Engineers' and Contractors' Requirements

WITH 288 exhibitors occupying all of the 79,000 sq.ft. of available space, the Annual Good Roads Show held in the Coliseum, Chicago, Jan. 11-15 in connection with the convention of the American Road Builders' Association, broke all attendance records as shown by registration at the door. The fact that practically the same number of exhibitors were present as at the 1925 show can be attributed only to lack of more space; the demand for space was approximately twice what the management had to offer. Charles M. Upham, state highway engineer of North Carolina, was general manager of the show.

Embodied in the machines shown were improved details developed during the greatest road building year in the country's history and developed in prospect of even greater road building and operating programs. But not only were the diversity of equipment and improved designs noteworthy. The number of orders taken by the manufacturers shows a distinct advance over previous years. As one manufacturer said: "This has been the best road show from our point of view that we have ever attended and we have been here a good many years. The idly curious visitors are practically extinct and every one shows an evident interest in the equipment."

Features of this year's show were a Mexican industrial exhibit and the big exhibit of the United States Bureau of Public Roads, consisting of a series of panels illustrating and describing facts about highway building, maintenance and operation.

Before entering into the detailed features of the different machines, a few general trends of equipment used in road construction and operation may be noted as a result of a study of the show.

General Trends

CONSIDERING the 1926 Road Show in its entirety, several distinct trends were noticed. These trends were not only evident along the line of improvement in machine details but were also reflected in the increased showing of certain types of equipment. The fact that highway operation has assumed its place as an equal and inseparable factor with highway construction contributed an example of this type of trend. More exhibits of highway markers and traffic control devices were shown than ever before. New and improved machines for painting guide lines, additional models of patrol graders and rollers, asphalt patching plants, guard rails, and various designs in snow plows, among other things, furnished further evidence of this trend.

In design details where the major trends continue to be noted, manufacturers have improved their machines with two objectives in view—first, comfort of the operator in running and maintaining the equipment, and second, increased economy in operation through faster speed, larger output and stronger materials. Gasoline power shovels have been made more flexible and easier to handle by air operated clutches and direct-connected air engines. Cut gears running in oil and flood lubrication systems have been incorporated in more machines than formerly. The use of cast steel in place of cast iron and the use of alloy steels is still on the upgrade. In fact, fabricating parts, furnished by specialist manufacturers, and accessory equipment representing refinements in operating and maintenance standards are being used in added numbers on practically all types of road building equipment. Trends evident last year in the increased use of roller and ball bearings and of rubber tires continued. Although the small portable pieces of equipment are still predominant, the large and heavy units show a tendency to increase in size and weight. Bucket elevators are being made higher, the concrete mixer having a six-bag capacity on a 1:3:6 mix is the new product of several companies, higher and wider snow plows are being used, and a grader with a 22-ft. blade and a finishing machine doing all the necessary operations, including tamping, were features of the show.

Road building specifications, as in other forms of construction, are requiring more accurate proportioning of aggregates. Volumetric hoppers have increased in number and the use of weighing hoppers is being extended. One manufacturer featured an inundator for sand measurements, designed to eliminate the inaccuracies in proportioning, due to the bulking action of the sand. Another manufacturer featured a portable bin and measuring hopper unit completely automatic in its operation. Construction of half-width pavements has caused a reduction in the tread width of concrete mixers. One mixer had an adjustable tread width. Speed in mixer operation is obtained by synchronizing the operations that make up a complete mixing cycle and by the use of larger water valves and compressed air so as to get the water into the mixer drum in a shorter time.

In the space available for this report it is impossible to go into any considerable details concerning each particular machine of a manufacturer. Furthermore, many of the machines and their features are well known in the road building field and a detailed description is not necessary.

Power Shovels and Cranes

IN THE power shovel field, several radical changes from conventional design were outstanding. This was especially true of the large gasoline shovels. Improvements on these machines have been made with a view to easier operation of the friction clutches or the elimination of them altogether. The new gasoline shovel of the McMyler-Interstate Co. was an example of the first type, the friction hoist clutch being operated by a ram mechanism similar to that used on steam shovels but in this case operated by air. This machine also featured a single chain drive for the shipper shaft designed so that the boom angle can be changed without altering the length of the crowd chain. Two independent power drums are available for crane duty on this equipment.

The Erie gas and air shovel shown for the first time at the show eliminates friction drives for the crowding and swinging motions by substituting direct-connected air engines. The machine thus has an engine for each operation, the gasoline power plant being used for hoisting. A new model Erie steam shovel of 1 yd. capacity was also shown incorporating more power and more speed than used on the older models. Over 100 improvements in construction details were made on this new machine.

Simplicity in shipper shaft mechanism was one of the outstanding features of the new 75-hp., 1-yd. gasoline shovel of the Thew Shovel Co., one shaft, one pinion and a driving sprocket being all that is used. All clutches are power operated. Dimensions are for a ¾-yd. machine while the working capacity is about 1¼ yd.

Diesel engines are being specified as optional equipment on practically all shovels. Several were shown equipped with this kind of power at the show. The Northwest Engineering Co. had its shovel powered with the new Cummins four-cylinder Diesel in operation on a vacant lot across the street from the Coliseum. The Northwest gasoline shovel and crane shown in the Coliseum had an improved cab with rounded end giving more room for the operator. The crane was equipped with a 45-ft. boom. Harnischfeger Corp. also exhibited a 1-yd. shovel equipped with a 76-hp. Diesel engine. A new truck crane with a 25-ft. boom, ½-yd. bucket and powered with a 40-hp. gasoline engine was also a part of this exhibit. The ½-yd. shovel and crane of the Brown Hoisting Machinery Co., that was shown, contained only 18 gears in the

entire mechanism. Link Belt's shovel featured a manganese steel bucket and chrome steel crawler treads. Shock absorbers on the Koehring shovel cushions sidewise pressures on the dipper.

The skimmer scoop type of machine was shown in operation by several manufacturers. Byers Machine Co. exhibited two of its excavators, one with the shovel and one with a skimmer scoop. Both of these machines may be converted for hoe type, clamshell and dragline buckets. The Insley excavator with a ¾-yd. shovel attachment has been improved by the use of a boom 2 ft. longer. Two speeds forward instead of three as formerly are being used. The weight has been increased from 18,000 to 20,000 lb. Other manufacturers exhibiting skimmer scoop machines were the Keystone Driller Co. and Bay City Dredge Works. The latter company had a ¾-yd. machine operating on an adjacent lot. The propelling speed on this machine has been increased and alloy steel has been substituted in the differential and axles. All iron castings have been eliminated and cast steel is being used instead.

The Mandt Shovel Co. featured a shovel built around a Fordson tractor. Other manufacturers showing shovels were Speeder Machinery Corp., Osgood, Orton & Steinbrenner, and the Russell & Co.

The latest development in crane mobility was featured by the Universal Crane Co. in its 5-ton, full circle crane mounted on the rear of a 5-ton Mack truck. Jacks and stirrups instead of outriggers give stability to the machine and yet permit it to move forward while carrying a load. Cut steel gears are new features on this equipment.

Grading Machinery and Dump Wagons

GRADING equipment was especially evident for patrol and maintenance purposes, although several of the larger types of elevating loaders were shown. To the many models of rubber-tired patrol graders built around the Fordson power plant, have been added several built around larger power units. The largest of these, shown by the Austin-Western Road Machinery Co., was a rubber-tired patrol grader built around a McCormick-Deering 15-30 tractor. This company also exhibited a leaning wheel grader and a new tractor-pulled grader which incorporates a blade control mechanism eliminating lost motion by means of ball and socket lifting arms.

The patrol grader exhibited by the Stockland Road Machinery Co. featured a frame construction that permits the use of the blade on a 1:1 inside ditch slope. The Stockland combined grader and scarifier has added replaceable chromium alloy tips on the scarifier teeth.

One of the entirely new innovations of the show was the end-loading street excavator manufactured by the Western Wheeled Scraper Co. This machine is for use in alleys and other cramped places. The new Fordson power patrol grader of the Good Roads Machinery Co. featured a friction power hoist on the scraper and scarifier and utilized rubber tires. This machine was different from some of the other Fordson patrol graders in that the Fordson power unit sets on top of the frame rather than being hung below it and near the ground. The new Galion Jr. machine combined planer, roller, scarifier and tractor. This and the Fordson grader featured a worm gear lift equalizer for the scrapers.

The leaning wheel grader of J. D. Adams & Co. uses a one-piece rear axle; other manufacturers showing small patrol graders were the Wehr Co. and the Russell Grader Mfg. Co., featuring a tight-fitting joint with take-up adjustment.

A power scraper with a 20-ft. reversible blade hydraulically operated by three cylinders and weighing 1,000 lb. is used on the new power scraper of the Gilbert Mfg. Co. The power unit is either a McCormick-Deering 15-30 or a 10-20 tractor.

The dump wagons of the Little Red Wagon Co. are designed so that the doors remain on top of the load after it is dumped. The Baker Mfg. Co. exhibited a self-loading 1¼-yd. scraper and the Perry Co. showed an automatic fresno scraper for tractor haulage which is operated from the tractor operator's seat. LaPlant-Choate showed a scraper with a hydraulic type lift using oil. The oil pump attaches to the power take-off of the tractor.

Road Rollers

SMALL-SIZED road-rollers were much in evidence at the show. These are built in four or five different sizes and usually incorporate scraper and scarifier attachments. Fordson power plant rollers were exhibited by the Good Roads Machinery Co., and Galion Iron Works & Mfg. Co. In contrast to these machines was the four-cylinder 10-ton motor roller with pneumatically controlled scarifier of the Austin-Western Road Machinery Co. and the 10-ton roller of the Galion Iron Works & Mfg. Co., featuring a steel plate frame ½ in. thick. The 10- and 12-ton rollers of the Huber Mfg. Co. utilize chrome nickel steel gears in the transmission. J. I. Case Threshing Machine Co. also exhibited a 10-ton gasoline and kerosene roller with air-operated scarifiers and an electric starter.

Between the small Fordson rollers and the heavy 10-ton rollers was the small roller of the Austin-Western Road Machinery Co., built around a McCormick-Deering 10-20 tractor. This company also exhibited a 4-cylinder 10-ton motor roller with pneumatic scarifier.

A perforated roller made of steel wire mesh was shown by the Perforated Roller Works. This roller is used in finishing concrete pavement, its function being to release the air and water and increase the density of the concrete.

Part II of Road Show Report Next Week

On account of the size of the 1926 Road Show it has been necessary to publish this report in two parts. Even then much practical information has had to be condensed to a considerable extent. The first installment appears here.

Next week the final installment will be concerned chiefly with:

Hoists	Snow Plows
Trench Excavators	Grab Buckets
Crushing Plants	Industrial Locomotives
Pumps	
Street Sweepers	Motor Trucks and Tractors
Gasoline Engines	
Air Compressors	Traffic Control Equipment
Materials	

Concrete Mixers

IN THE field of concrete mixers the trend toward larger machines was especially notable. Chain Belt, Foote, Smith and Koehring all featured a 27-E paver, having a six-bag capacity on 1:3:6 mix. These machines have been designed for fast operation and all include a number of notable improvements. Synchronization of charging and discharging actions on the Chain Belt mixer keeps two batches going through the machine at all times. The distributing bucket is adjustable to thickness of pavement. A new cooling system is used consisting of spiral coils in a cooling tank. An added refinement on the show model was the use of lights on the mixer skip for night operation.

T. L. Smith's 27-E has been designed with a reduced tread width for operation in half-width streets. A 3½-in. water valve assures fast discharge of the water into the drum. The Koehring mixer utilizes an adjustable tread width. Double equalizing cables are used in hoisting the skip. The upper frames of all of these machines are collapsible permitting them to pass under low obstructions when being moved along the road. The Koehring machine also incorporates a steering device that turns the machine almost as easily as an automobile. The overall height of this paver is lower than that of the old 21-E.

Ransome Concrete Machinery Co. featured a 21-E paver giving a faster water discharge by means of a balanced valve. These machines feature oversized drums for efficient operation on inclined roads. Fewer parts are used and synchronizing of operations is made possible.

In addition to these companies, about a dozen other manufacturers exhibited smaller mixers of the tilting barrel type, and small pavers and building mixers in 7- and 13-cu.ft. sizes. Many of these smaller mixers were of the trailer type, mounted on rubber tires and roller bearings. The Knickerbocker Co. exhibited a 7-S mixer mounted on springs and rubber tires. An improvement over last year on this machine was the substitution of pressed steel drums for the cast-iron drums. The engine clutch is also enclosed, running in oil instead of being outside on a shaft. The 7-S mixer of the Marsh-Capron Co. was also improved by the use of cushion springs, roller bearings, solid rubber tires and pressure lubrication cups. The Construction Machinery Co. exhibited a 13-E paver powered with a 30-hp. Hercules motor, the machine featuring simultaneous control of several operations. It was of the tilt-

ing type. The trailer type concrete mixers of the Remmell Mfg. Co. exhibited in 2- and 3-cu.ft. sizes utilized a direct gear drive instead of a chain. Other manufacturers showing 7-S mixers were the Leach Co., Republic Iron Works, American Cement Machine Co., and the B. M. Cropp Co.

Bituminous Pavement Equipment

THE large equipment of this class shown at the show consisted of asphalt pressure distributors mounted on 5-ton motor trucks. Kinney Mfg. Co., Charles Hvass & Co., E. D. Etnyre & Co. and the Barrett Co. exhibited these types. In addition to a small asphalt patching plant, the Mosher Mfg. Co. showed a model of a railroad car dumping plant of one-ton capacity.

Small plants for road maintenance and repair were exhibited by two companies. Littleford Bros. had as its principle exhibit an Anderson road repair outfit which heated and dried the aggregate, discharging it on to a pan at the rear where the mixing with the asphalt was done by hand. The new type rotary fan heater for large jobs was shown. This consisted of a cylindrical drum direct-connected to a gasoline engine. Flights and a screw conveyor work the sand both ways so that it discharges hot at the same end where it was charged cold.

The patchwork burner of the Chausse Oil Burner Co. is offset from the main machine so that it can work along street-car tracks permitting the car steps to clear the equipment. The newest piece of equipment was a machine for filling cracks in concrete pavements. In addition to applying the asphalt to the cracks, this machine first blows the dirt out with hot air, at the same time heating the crack to about 1,200 deg.

Aggregate Handling Equipment

PROPORTIONING and handling aggregate for the concrete used in road building is constantly commanding more attention and additional designs in equipment are being introduced to approximate more closely the results of laboratory experience in actual road construction practice. Self-feeding elevating bucket loaders to which are attached volumetric aggregate measuring hoppers were shown at the show to a considerable extent. The George Haiss Mfg. Co. featured a creeper loader to which was attached its improved hopper featuring micrometer adjustment by means of set screws which hold the telescoping parts of the hopper together. Interchangeable with the boom on this creeper was shown a snow loader and scraper elevator complete with feeding propellers. A portable belt conveyor of the troughing type was also showe. The Barber Greene Co. exhibited its bucket loader and measuring hopper, on which a fixed strikeoff assures uniform batches. Chrome steel crawler treads were used on the Link Belt elevating loader exhibited at the show. Companies showing conveyors of the belt type were the Chicago Automatic Conveyor Co. and the Burch Plow Works.

Batching plants consisting of bins and measuring hoppers were exhibited by several manufacturers and took their place as examples of some of the larger equipment. Blaw-Knox Co. exhibited a 72-ton batcher plant, equipped with measuring hopper for the stone and an inundator for the sand. A 35-ton portable batcher plant with folding legs was also shown. This plant was equipped with measuring hoppers using both the volumetric and weighing systems. A small-size inundator for use on small mixers was shown for the first time. An Erie Aggremeter plant with both volume and weighing hoppers was shown by the Erie Steel Construction Co. The bin shown was of 13-ton size.

A 40-cu.yd., portable bin and hopper was exhibited by the Butler Pin Co. A feature of this plant was that both the stone and sand hoppers could be operated on one lever or independently. The weighing hopper on this plant was characterized by the lack of delicate parts. Two bins were exhibited by the Heltzel Steel Form & Iron Co. The first of these was a demountable, boltless steel frame structure connected by drift pins, supporting a boltless, rivetless hopper. The other plant shown was portable, equipped with automatic measuring hoppers. These hoppers were in constant operation at the show, opening and closing by means of electric power. The gates from the main bin into the measuring hopper were synchronized in their operation with the drop gates in the hopper, so that as the stone hopper was filling the sand hopper was discharging into the truck below. The only thing necessary for the truck driver to do is to place his truck under the hopper and turn on the switch.

Finishing Machines and Road Forms

AN UNUSUAL number of designs in road forms was seen at the show. These forms differed to the greatest extent in joint construction. Also, curb and gutter forms are made interchangeable with sidewalk forms and also adaptable to various heights of curb. The Heltzel Steel Form & Iron Co. introduced a new form that is adjustable by means of a yoke passing around each 10-ft. section of curb and gutter form. This yoke makes possible an adjustment for various heights, for either a beveled or a straight front, and several other combinations. The yoke contains a slot into which division plates may be placed and removed after initial set. This eliminates ragged joints as is sometimes the case when division plates are pulled out after the forms are removed. The road form has been improved so that the stake lock is entirely enclosed keeping any concrete out of the stake pockets. Heltzel also exhibited a center and transverse joint machine which places contraction joints in the pavement. The Dravo Contracting Co. features a road form using square stakes and two braces between each stake pocket. This form can be taken from the line horizontally without disturbing any of the rest of the forms. The road forms of the Hotchkiss Steel Products Co. may be hung on the stakes at any height that brings the top of the forms to grade. Metal Forms Corp. featured a transition attachment for changing from curb and gutter to highway curb where necessary. Truscon Steel Co. also had an exhibit of their road forms. A machine running on the road forms for covering freshly laid pavement with canvas was exhibited by H. Lintz & Son.

The new Lakewood Road Finisher combines the functions of two machines, namely the screed and the tamper. At the front of the machine is an all-steel strikeoff, 12 inches wide on the bottom and adjustable for crown. This strikeoff has a lateral motion of from 5 to 7 in. The tamper consists of a wood beam extending the full width of the road, hung on springs from each side of the machine; it can be made to hit lightly or to strike heavy blows. The tamper may be operated independently of the screed. At the rear of the machine is a belt, to be used for final finish. The machine is very rigidly constructed an automotive type of sliding gear transmission encased in an oiltight housing and provided with Timken bearings being used. The machine has two speeds forward and two speeds reverse, with traction wheels 14 inches in diameter. Lakewood also exhibited the Carr road forms, designed especially for mechanical finishing and a steel subgrader, adjustable for widths. A. W. French & Co. exhibited the Ord road finisher with screeds front and rear. A new subgrader of heavy construction which carries the dirt to the outside of the forms on a belt conveyor was a new product of this company.

Highway Industries Exhibitors Hold Annual Meeting

The Highway Industries Exhibitors Association composed of manufacturers of construction materials and equipment practically all of whom were exhibitors at the Road Show, held its annual meeting at the Palmer House in Chicago, Jan. 14. Besides the transaction of the necessary routine business, an election was held to fill the offices vacated by four directors whose term had expired. The new directors elected for a term of 3 years were: F. T. Hase, C. H. & E. Mfg. Co., Milwaukee; W. R. Adams, J. D. Adams & Co., Indianapolis; W. R. Karll, Le Roi Co., Milwaukee. C. R. Ege, Portland Cement Association, Chicago was re-elected.

Immediately following the general meeting, a directors' meeting was held at which C. R. Ege was elected president, C. S. Messinger, Chain Belt Co., Milwaukee, vice-president; Fred G. Hudson *Engineering News-Record*, secretary; and W. R. Karll, treasurer.

The highway Industries Exhibitors Association is governed by a board of 12 directors. The others directors who retain office at this time are: P. L. Griffiths, American Tar Products Co., Pittsburgh; Leon Gardiner, Lakewood Engineering Co., Cleveland; C. V. R. Fullenwider, Phillip Carey Co., Cleveland; C. R. Dodge, Northwest Engineering Co., Chicago; Chester H. Lehman, Blaw-Knox Co., Pittsburgh; S. M. Williams Autocar Co., Ardmore, Pa.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
January 21, 1926	$22,012,000	$39,472,000	$61,484,000
January 14, 1926	15,116,000	26,543,000	41,659,000
January 22, 1925	7,603,000	24,281,000	31,884,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to date			
1926	63,374,000	99,470,000	162,844,000
1925	49,608,000	78,914,000	128,522,000

Rate of Output in Basic Building Materials Dangerously High

Present Mill Capacity Will Support Demand Greater Than That of Record Year 1925

THE production capacity of the country, so far as basic construction materials are concerned, is probably greater than the industry actually requires, according to comparisons of returns for 1925 with those of the year preceding.

Money value of 1925 building contracts (commercial and industrial) gained 41 per cent over 1924; construction other than buildings increased 12 per cent.

Allowing for the decreased purchasing value of the 1925 dollar, compared with the pre-war basis, the gain in actual physical volume of materials used was probably not more than 31 per cent, comparing last year with 1924.

Mills throughout the country produced 20 per cent more steel, 8 per cent more cement and 5 per cent more lumber during 1925 than in the year preceding. The consumption of common brick increased 11 per cent.

New records were made in steel and cement production; the lumber output was slightly larger than for any year since 1916; brick gained over any previous year since 1909.

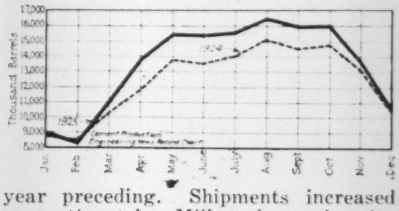
The impression gained from these figures is that 1924 was a heavy production year with 1925 but slightly heavier. Considering the great gain in volume and value of construction, a commensurate increase was not necessary in output of materials, because of the extensive mill capacity and quick transportation facilities.

Taking four of the basic materials separately, the situation is as follows:

Steel—Ingot output for the country during 1925 totaled 44,186,977 tons, against 36,811,157 in 1924, according to calculations of the American Iron & Steel Institute. Fabricated structural steel sales totaled 2,601,000 tons (December estimated) against 2,363,500 tons in 1924. Unfilled orders on books of the U. S. Steel Corp., Dec. 31, 1925, totaled 5,033,364 tons, compared with 4,816,676 on the same date in 1924. Steel exports have shown a steady drop from year to year, since 1920.

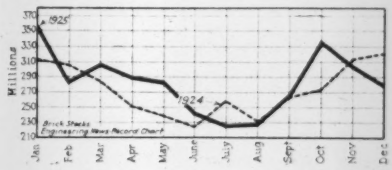
Lumber—The maximum estimate for 1925 is placed by the National Lumber Manufacturers Association at 38,000,000,000 ft. compared with 37,500,000,000 ft. during 1924. The 1925 output would make over 1,000,000 ordinary dwelling houses, according to the Association.

Cement—This industry broke all previous records with 161,298,000 bbl. in 1925, against 149,358,000 bbl. for the

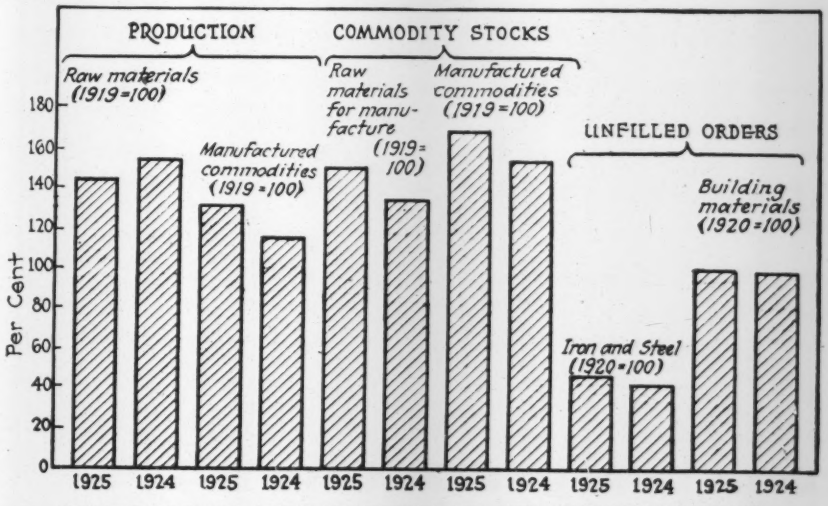


year preceding. Shipments increased proportionately. Mill stocks are heavier than at any time since May, 1925. A new mill in the Detroit district is reported ready to start producing.

Brick—Consumption of common brick in 1925 reached about 8,000,000,000 for the entire country, according to the



Common Brick Manufacturers Association of America. This is compared with 7,282,181,000 for the year preceding and practically the same amount in 1923.



PRODUCTION AND RESERVE STOCKS OF, AND DEMAND FOR, BASIC MATERIALS DURING MONTH OF NOVEMBER—U. S. DEPT. OF COMMERCE FIGURES, E. N.-R. CHART

Weekly Construction Market

BUILDING materials, in keeping with other commodities, show a very slight excess of price advances over declines in this week's market.

Lumber appears to be recovering from the recent holiday lull in some of the Western cities. Pine timbers are 50c. and fir, $1 per M. ft. above price levels of three weeks ago, in Chicago and Minneapolis respectively.

Linseed oil is tending downward throughout the entire country. The price at New York and Minneapolis is 0.3c. per lb. below the Dec. 31 level.

Lime in St. Louis in 1924, cost the Water Department of that city $11@$11.50 per ton; the 1925 rate was $8.15 per ton, f.o.b. water-works; recent bids on 1926 requirements ran $6.78, $7.07 and $7.39 per ton delivered. It is claimed that the acceptance of the low bid would effect a saving of $23,000 to the city of St. Louis for the year 1926, compared with the 1925 price.

Steel is featureless. Present quotations at Pittsburgh mill are: bars, $2@$2.10; plates and shapes, $1.90@$2.00 per 100 lb. in carload lots. As low as $1.60 per 100 lb. is mentioned on plates and as high as $2.10 per 100 lb. on shapes, the latter in less-than-carload lots.

Iron and steel demand are both slow, in the current market; scrap is not moving; tin plates and railway materials continue active.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb.	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.77½	3.35	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	+18.3%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	—43.00	54.00	50.20@51.20	53.00	64.00	51.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.70	2.30	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.50	2.00	2.25	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.40	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	+57.50	+37.75	49.50	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.25@2.75	+1.50	1.85	+2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	18.50	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	+.0977	.10	.075	.....	.075	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1112	+.0977	.10	.075	.07	.075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	—.91½	—.99	1.13	—.99	—1.05¾	—1.14	—1.08	1.12	1.14
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 7, the next on February 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.75). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4½ per cent, Jan. 18; year ago, 3 per cent.

Time loans: sixty-ninety days, also four-six months, 4⅜@4½ per cent.

Commercial paper: best names, 4¼ per cent; other names, 4¾ per cent.

On January 1, 1926

E. N.-R. Construction Cost Index Number 207.15

E. N.-R. Construction Volume Index Number 206

For Explanation and Details of Index Since 1913 See the First Issue of Every Month